Developing a bid evaluation system for the Portuguese Electric Transmission Company (REN) using MACBETH and decision conferencing

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The client

Portuguese Electric Transmission Company
Every week, REN launches several calls for tenders:

• Construction of:
  • New power lines
  • Up-rating of existing lines
  • Electrical facilities

• Supplying of:
  • Equipments
  • Systems of power substations
  • Development of engineering projects

The REN board asked for our collaboration to revise the bids evaluation system that was in use.

Diagnosis: Arbitrary hierarchical average sum of direct scores of bids, using an evaluation grid

• Scores taken as weights and weights taken as scores

• Weights of criteria based on direct judgements of relative importance:
  “The most common critical mistake” (Keeney, 1992)

Therapy: Rebuild the evaluation system entirely!
Key issues for model building

- Preference modelling should depend on each particular set of bids. Once the new evaluation model is built and agreed upon, it would be used repetitively.

- REN engineers that analyse the bids against each criterion will not go on assigning to each bid a numerical value score; rather, they should only appraise the performance of the bid on the criterion.

The approach

MCDA socio-technical approach:
MACBETH & Decision Conferencing

- ‘Decision-making’ Group: REN executive directors (6)
- Process consulting team:
  Facilitator: Carlos Bana e Costa
  1st analyst: João Lourenço
  2nd analyst: João Costa
- Software: M-MACBETH
**Model building tasks**

- Define family of evaluation criteria
- Define a descriptor of performances on each criterion, including two reference levels for weighting
- Construct a value function for each criterion
- Assess weights for the criteria
- Validate the requisiteness of the model upon a previous case

**Discussion the evaluation criteria**

Discussion output:
The benefit criteria are not common to all types of call for tenders

Implication:
A different model should be constructed for each type of similar call for tenders (4 different models)
Defining the evaluation criteria

1. Define two reference levels of performance: “good” and “neutral”

   **“Equipments plan” reference levels**

<table>
<thead>
<tr>
<th>Performance level</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time allocation by type of equipment</td>
<td></td>
</tr>
<tr>
<td>Allocation only by type of equipment (without time allocation)</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

2. Add more levels, covering the plausible range of performance

   **“Equipments plan” descriptor**

<table>
<thead>
<tr>
<th>Performance level</th>
<th>Qualitative level</th>
<th>Shot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time allocation by type of equipment and task</td>
<td>N1</td>
</tr>
<tr>
<td>2</td>
<td>Time allocation by type of equipment</td>
<td>N2</td>
</tr>
<tr>
<td>3</td>
<td>Allocation only by type of equipment (without time allocation)</td>
<td>N3</td>
</tr>
<tr>
<td>4</td>
<td>Allocation only by type of equipment (without time allocation)</td>
<td>N4</td>
</tr>
<tr>
<td>5</td>
<td>It does not present any allocation</td>
<td>N5</td>
</tr>
</tbody>
</table>

3. Describe each performance level carefully, clearly and unambiguously
1. Assess and discuss MACBETH qualitative judgements of difference of attractiveness between levels...

2. Discuss the MACBETH value scale...

... discussing and resolving judgement inconsistencies, when necessary

... and adjust it if necessary to achieve an interval scale

Weighting the benefit criteria

Reference levels ‘Good’ and ‘Neutral’ ...

... set up the anchor points for meaningful weighting
Weighting the benefit criteria

Qualitative swing weighting procedure:

1. Rank the ‘good - neutral’ swings by their overall attractiveness

2. Judge qualitatively the overall attractiveness of each swing

3. Compare qualitatively the most important swing to each of the others

4. Compare qualitatively each two swings consecutive in the ranking

4. If desired, complete the matrix of weighting judgements
5. Discuss and adjust the MACBETH swing weights scale...

... or the correspondent normalised MACBETH weights

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**Discussing the cost-benefit trade-off**

Strategic decisions taken by the REN board:

- Cost and benefit weights must be equal (50%)
- ‘Neutral’ cost equal to expected cost
- Cost value function must be linear

Operational implications:
Set the ‘Good’ cost consistently with REN board’s decisions by making the appropriate cost-benefit trade-off:

(neutral cost, good benefits all over)
indifferent to

(x euros, neutral benefits all over)

value of x euros = 100; value of expected cost = 0
**Defining the final weights**

Normalise the swing weights of benefit criteria...

... so that they sum equals 50%

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**Validating model requisiteness**

- Intermediate performance levels were added to allow for hesitation in bid performance appraisal

<table>
<thead>
<tr>
<th>Performance level</th>
<th>Qualitative level</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>Time allocation by type of equipment and task</td>
<td>N1</td>
</tr>
<tr>
<td>N2++</td>
<td>N2++</td>
<td></td>
</tr>
<tr>
<td>N2+</td>
<td>N2+</td>
<td></td>
</tr>
<tr>
<td>N2 = Good</td>
<td>Time allocation by type of equipment</td>
<td>N2 = Good</td>
</tr>
<tr>
<td>N3</td>
<td>Allocation by type of equipment and task (without time allocation)</td>
<td>N3</td>
</tr>
<tr>
<td>N4 = Neutral</td>
<td>Allocation only by type of equipment (without time allocation)</td>
<td>N4 = Neutral</td>
</tr>
<tr>
<td>NaN</td>
<td>NaN</td>
<td></td>
</tr>
<tr>
<td>N5</td>
<td>It does not present any allocation</td>
<td>N5</td>
</tr>
</tbody>
</table>
Using the model

1. Analyse the bids

2. Enter bids’ performances into the model

Analysing the model outputs