Use of a multi-criteria evaluation process for participative localization of windy parks in Corsica: use of the XMCDA format and feedback

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Context and Objectives

- Software and Web service development
  - The MECADEPPE project
  - Find a formalism to represent data
- Try to use XMCDA and D3 in a real world case study of a multi criteria decision aiding problem
  - Real project of localization of wind farm
- Make a feedback and ask some questions
Summary

• Describing a real MCDA Problem
  – Localization of a wind farm in south Corsica
• XMCDA modelisation and D3 Deck utilisation
• Feedback : questions and feelings
  – Computer Scientist point of view
  – Annalist point of view
• Conclusion and Perspectives
Description of a real Multi Criteria Decision Aid case study: Localization of a wind farm in south Corsica

Experimental study ordered by the economic development agency of Corsica and the Corsican Collectivity to

– Guide regional choices
– Pay attention to the acceptability problems
– Make them more acceptable by the local social actors
Localisation of a wind farm in south Corsica

• How and where to locate a wind farm being integrated into the territory?

• A ranking problematic
  – Find some relevant places
  – Rank actions from the best to the worst: total preorder

• One of the first experience of the MECADEPPE software project

[Oberti, 2006] [Oberti, Muselli, Poggi, 2006]
The challenge

- Assist a multi-participatory decision process
  - Multi-constraints and multidisciplinary
    - Physics - Economics - Socials - Humans - Politics
  - Multi-actors (sixty actors)

<table>
<thead>
<tr>
<th>Groups of actors</th>
<th>Acronyms</th>
<th>Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic development Agency of Corsica (<em>economic operations</em>)</td>
<td>ADEC</td>
<td>2</td>
</tr>
<tr>
<td>Town council of Bonifacio</td>
<td>MAIRM</td>
<td>5</td>
</tr>
<tr>
<td>majority</td>
<td></td>
<td></td>
</tr>
<tr>
<td>opposition</td>
<td>MAIRO</td>
<td>2</td>
</tr>
<tr>
<td>town planning and other services</td>
<td>MAIRS</td>
<td>3</td>
</tr>
<tr>
<td>Regional direction of environment (<em>natures and landscapes” service</em>)</td>
<td>DIREN</td>
<td>3</td>
</tr>
<tr>
<td>Electricity of France</td>
<td>EDF</td>
<td>2</td>
</tr>
<tr>
<td>University of Corsica (<em>physics, economics and data-processing departments</em>)</td>
<td>UCPP</td>
<td>7</td>
</tr>
<tr>
<td>Local citizens</td>
<td>CITOYL</td>
<td>30</td>
</tr>
<tr>
<td>Tourists</td>
<td>TOUR</td>
<td>6</td>
</tr>
</tbody>
</table>
The process in three steps

- **Step 1**
  - Find the relevant territories

- **Step 2**
  - Simulate performances of a wind farm in each territories

- **Step 3**
  - Make a multi-criteria evaluation process for participative localization of the wind farm
  - Give a preferential ranking of the actions
Step 1: 5 potential territories

- Arapa, 334m
- Valle Torta, 82m
- Frasselli, 214m
- Francolo, 65m
- Corbu, 251m
Step 2: Simulate performances of the potential wind farms

- Use of the WindFarmer software
  - Optimization of the electrical production function

![Site Zoning](image1.jpg)

![Optimal positioning of wind turbines](image2.jpg)
Step 2: Simulate performances of the potential wind farms

- Use of the WindFarmer software
  - Optimization of the electrical production function
  - Visual impact
  - Sound emergences

Step 2: 3 potential actions
Step 3: the participatory decision process

- Proposed by [Oberti, 2004]
### Step 3: Preoccupations of actors and choice criteria

<table>
<thead>
<tr>
<th>Axes of preoccupations</th>
<th>Associated criteria, (unities/items), optimizations</th>
<th>Principles of criteria construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>energetic</td>
<td>PROD: net annual producible, (MWh/year), maximization</td>
<td>Probabilistic wind analyzes (Wasp). Estimated function of electrical production (WindFarmer). Calculation of the electric losses (network connection, stops voluntary or fortuitous). Estimated quantity of electric energy delivered to the community of users.</td>
</tr>
<tr>
<td>visual</td>
<td>VBON: visibility from the town of Bonifacio, (%), minimization</td>
<td>Fraction of the wind machine surface, viewable with the naked eye, since an observation point of the landscape (WindFarmer). Aggregation of type “maximum or/and average”</td>
</tr>
<tr>
<td></td>
<td>VHAB: visibility with the closest habitation, (%), minimization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VAIL: visibility elsewhere, (%), minimization</td>
<td></td>
</tr>
<tr>
<td>ecological</td>
<td>DECO: potential ecological degradation, (points on 36), minimization</td>
<td>Incidence of the wind farm (building site, delivery, activity) with the environmental functions (ecological areas, hunting preserves, sourcing of the migratory birds, ground impact)</td>
</tr>
<tr>
<td>spatial</td>
<td>CONF: risk of conflicts with uses or functions of the site, (non-existent, limited, moderated, considerable, high), minimization</td>
<td>Incompatibility, or not, of the wind farm with other private/public uses of the site. Deprivation, or not, of a collective interest project, probable even realizable, in the short or medium term.</td>
</tr>
</tbody>
</table>
Step 3:
The enlarged performances table given by the participative process

<table>
<thead>
<tr>
<th></th>
<th>CRITERIA</th>
<th>PROD</th>
<th>VBON</th>
<th>VHAB</th>
<th>VAIL</th>
<th>DECO</th>
<th>CONF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terms of scales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimization</td>
<td></td>
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<tr>
<td>Simulated wind</td>
<td>Frasselli</td>
<td>35902</td>
<td>50</td>
<td>56.25</td>
<td>80</td>
<td>10</td>
<td>1</td>
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<tr>
<td>projects</td>
<td>Francolo</td>
<td>20975</td>
<td>5</td>
<td>52.5</td>
<td>25</td>
<td>1</td>
<td>3</td>
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<tr>
<td></td>
<td>Valle Torta</td>
<td>28950</td>
<td>0</td>
<td>40</td>
<td>3.7</td>
<td>2</td>
<td>1</td>
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<td></td>
<td>MAIRO</td>
<td>6.49</td>
<td>23.15</td>
<td>17.57</td>
<td>23.15</td>
<td>6.49</td>
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<tr>
<td></td>
<td>ADEC</td>
<td>5.35</td>
<td>18.93</td>
<td>18.93</td>
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<tr>
<td></td>
<td>DIREN</td>
<td>5.61</td>
<td>19.82</td>
<td>15.11</td>
<td>19.82</td>
<td>19.82</td>
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<tr>
<td></td>
<td>CITOYLI</td>
<td>10.07</td>
<td>21.93</td>
<td>18</td>
<td>21.93</td>
<td>6.14</td>
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<tr>
<td>Criteria thresholds by actors</td>
<td>Indifference</td>
<td>UCPP1</td>
<td>UCPP2</td>
<td>5%</td>
<td>1</td>
<td>0</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>5%</td>
<td>10%</td>
<td>5%</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preference</td>
<td>20%</td>
<td>30%</td>
<td>20%</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Veto</td>
<td>100%</td>
<td>50%</td>
<td>6</td>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equivalent to ten traditional performances tables
Step 3: Result of the process, recommendation of action

- Application of ELECTRE III method on the ten performance tables
  - Check out coincidence or not of the ranking
- All the result converge

<table>
<thead>
<tr>
<th>Upward (ascending) distillation</th>
<th>Downward (descending) distillation</th>
<th>Final outranking graph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valle Torta</td>
<td>Francolo</td>
<td>Frasselli</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Median preorder</th>
<th>Final preorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank 1</td>
<td>Valle Torta</td>
</tr>
<tr>
<td>Rank 2</td>
<td>Francolo</td>
</tr>
<tr>
<td>Rank 3</td>
<td>Frasselli</td>
</tr>
</tbody>
</table>

4 veto situations
Use of XMCDA formalism to submit the problem to D3

Feedback: questions and feelings
Submission to the D3 web services

- Rubis choice XMCDA 2
  - Seemed to be the method the most appropriate

- Results obtained

### Rubis Choice Recommendation

<table>
<thead>
<tr>
<th>#</th>
<th>Choice set</th>
<th>Determinateness</th>
<th>Outrankingness</th>
<th>Outrankedness</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>{ C, }</td>
<td>97.96</td>
<td>93.87</td>
<td>0.00</td>
<td>Best choice</td>
</tr>
</tbody>
</table>

### Potentially Bad Choices

<table>
<thead>
<tr>
<th>#</th>
<th>Choice set</th>
<th>Determinateness</th>
<th>Outrankedness</th>
<th>Outrankingness</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>{ A, }</td>
<td>90.36</td>
<td>77.20</td>
<td>0.00</td>
<td>Bad choice</td>
</tr>
</tbody>
</table>
XMCDA Feed backs : questions (i)

- Can XMCDA represent data of ranking problems like ELECTRE III?
  - Is there a tag for the discrimination threshold used with the outranking credibility index?
- Can XMCDA be used to support multi-actors methods?
  - It seems we can stated only one performances table
  - In our case there are ten performances tables
  - Ten XMCDA files?
XMCDA Feed backs : questions (ii)

• Geographic data not taken into account
  – GIS can take into account criterion and their weights: why MCDA methods could not incorporate geographic dimension?
  – Possible improvements?
    • Positioning the actions
    • Solving actions constraints (identify potential actions)
    • Computing some criteria (for example: computing the amount of energy)
    • Needed in the MECADEPPE project (Web service)
  – Try to use already defined standards?
    • KML, http://www.opengeospatial.org/standards/kml/
    • GML, http://www.opengeospatial.org/standards/gml/
XMCDA Feed backs : feelings (i)

• Computer scientist point of view
  – Easy to use with the « Quick dive into XMCDA-2.0 » examples
  – Need to represent the knowledge
• Why do not use Ontologies?
  – Ontology is about the exact description of things and their relationships
  – There is already one : “The MCDA Ontology describes the concepts for describing a multiple criteria decision analysis problem and its solution”
    http://www.daml.org/2002/05/mcda/mcda-ont
XMCDA Feed backs : feelings (ii)

• Analyst (coordinator) point of view
  – All the XML rules not always well known and followed
    • A good editor or forms are needed
  – XMCDA does not include all the information in MCDA process from the description to the final recommendations
    • Is it the goal?
    • XMCDA dedicated to computing and not to problem description?
XMCDA Feed backs: feelings (iii)

• Search for others existing (or not) XML based languages?

• The needs to use XML files in the field of MCDA to support
  – the computing (web services, XMCDA)
  – the all process description (knowledge base, reuse of data),
    • the validation of actions recommendations
      (representation of actors opinions concerning the recommendations )
  – the evaluation process unfolding (connected with GUI, importance of actors role)
Conclusion & Perspectives
Conclusion

- Succeed in using XMCDA to represent data of the problem of localization of a wind farm in south Corsica
- We obtained good results even if not complete
- We ask many questions!
- We would be happy to welcome you in Corsica for a next workshop!
Perspectives

- Follow the work on the MECADEPPE XML based formalism
- Using Ontologies in order to
  - share common understanding of the structure of information among people or software agents
  - enable reuse of domain knowledge
  - make domain assumptions explicit
  - separate domain knowledge from the operational knowledge
  - analyze domain knowledge
Thank you for your attention.

Questions?
Bibliography


