Venue: Port of Oostende
Date: 8th September 2016
Presenter: Negar Akbari

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Ports play a major role in the three phases of the installation, O&M and decommissioning of the wind farms.

Offshore wind components are increasing in size and ports need to adapt to this change by developing more facilities.

Decision support tools for determining suitable ports and onshore bases for the offshore wind sector are in demand.
Components are delivered to installation ports for preassembly and storage.
Role of ports in the offshore wind industry-O&M

- O&M ports provide regular service for the entire lifecycle of the wind farm.

Workboats at Port of Oostende
Why do we need models for port suitability assessment?

- Models can help us to conceptualize, design and strategise.
- Models can help us to recognise patterns in the data.
- Models can help us to identify and rank choices.
- Models can help us in our decision making.
Decision makers frequently have to make decisions in the presence of multiple, conflicting criteria.

Multi-criteria decision making methods (MCDM) includes methods such as, Analytical Hierarchy Process (AHP), Analytical Network process (ANP), Fuzzy set theory based decision making, and Goal Programming.

MCDM has been significantly used over the last several decades in different application areas.
Hierarchy models composed of different port criteria were developed.

These models were then validated by industry experts.

In order to determine the relative significance of the criteria, pairwise comparison questionnaires were sent to 5 experts in the offshore wind industry.

The result of the questionnaires were aggregated and the final weight for the criteria was determined.
Hierarchy structure for the installation port

Installation Port

Physical characteristics
- Quay length
- Loadbearing capacity
- Port's depth
- Seabed suitability
- Component handling

Connectivity
- Offshore wind farm
- Road networks
- Key component suppliers

Layout
- Manufacturing facility
- Potential for expansion
- Storage availability
- Laydown area availability

Set of Alternatives
- Port 1
  - Ro-Ro
  - Lo-Lo
  - Heavy cranes
- Port 2
- Port n
  - Open storage
  - Covered storage
  - Bearing capacity
  - Laydown area
  - Access to quayside
Installation port criteria weight

- Seabed suitability: 10%
- Lo-Lo capability: 4%
- Ro-Ro capability: 1%
- Heavy cranes: 2%
- Quay length: 7%
- Quay load bearing capacity: 14%
- Port's depth: 11%
- Distance to offshore site: 19%
- Distance to key component supplier: 5%
- Distance to road: 3%
- Potential for expansion: 6%
- Component laydown area: 5%
- Component laydown area access to quay side: 3%
- Storage loadbearing capacity: 4%
- Open storage area: 2%
- Covered storage area: 1%
- Component fabrication facility: 3%
### Example of input data for the port selection model

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Priority Weight</th>
<th>Alternatives weight</th>
<th>Final Score = Priority weight * Alternatives weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Harwich</td>
<td>Oostende</td>
<td>Hull</td>
</tr>
<tr>
<td>Seabed suitability</td>
<td>0.097</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Lo-Lo capability</td>
<td>0.038</td>
<td>0.767</td>
<td>0.767</td>
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<tr>
<td>Ro-Ro capability</td>
<td>0.006</td>
<td>0.673</td>
<td>0.673</td>
</tr>
<tr>
<td>Heavy cranes</td>
<td>0.019</td>
<td>0.767</td>
<td>0.137</td>
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<tr>
<td>Quay length</td>
<td>0.070</td>
<td>0.200</td>
<td>0.405</td>
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<tr>
<td>Quay load bearing capacity</td>
<td>0.139</td>
<td>0.164</td>
<td>0.767</td>
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<tr>
<td>Port’s depth</td>
<td>0.114</td>
<td>0.130</td>
<td>0.909</td>
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<tr>
<td>Distance to offshore site</td>
<td>0.194</td>
<td>0.905</td>
<td>0.511</td>
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<td>Distance to supplier</td>
<td>0.051</td>
<td>0.233</td>
<td>0.233</td>
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<tr>
<td>Distance to road</td>
<td>0.030</td>
<td>0.312</td>
<td>0.963</td>
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<tr>
<td>Potential for expansion</td>
<td>0.062</td>
<td>0.303</td>
<td>0.322</td>
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<tr>
<td>Component laydown area</td>
<td>0.053</td>
<td>0.961</td>
<td>0.369</td>
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<tr>
<td>Laydown area access to quay</td>
<td>0.028</td>
<td>0.363</td>
<td>0.363</td>
</tr>
<tr>
<td>Storage loadbearing capacity</td>
<td>0.042</td>
<td>0.327</td>
<td>0.963</td>
</tr>
<tr>
<td>Open storage area</td>
<td>0.021</td>
<td>0.247</td>
<td>0.227</td>
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<tr>
<td>Covered storage area</td>
<td>0.007</td>
<td>0.481</td>
<td>0.386</td>
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<tr>
<td>Component manufacturing facility</td>
<td>0.029</td>
<td>0.137</td>
<td>0.767</td>
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<tr>
<td>Total</td>
<td></td>
<td></td>
<td>0.499</td>
</tr>
<tr>
<td>Rank</td>
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<td></td>
<td>4.000</td>
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</tbody>
</table>
Port selection tool demo
The most important logistics requirements for ports to support the development of the offshore wind sector are determined.

A decision making model for shortlisting and selecting the most suitable port for an offshore wind farm is developed.

The model is useful for ports authorities to compare their port attractiveness against other ports.
Thank you for your attention

Q&A