Venue: *Port of Oostende*
Date: *8th September 2016*
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Role of ports in the offshore wind sector

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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 component 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.

Role of ports in the offshore wind industry-installation

- Components are delivered to installation ports for preassembly and storage.

Greenport Hull

Port of Oostende

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?

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- 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.

How to make decision in the presence of multiple criteria?

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- 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.

Formulation of the AHP model

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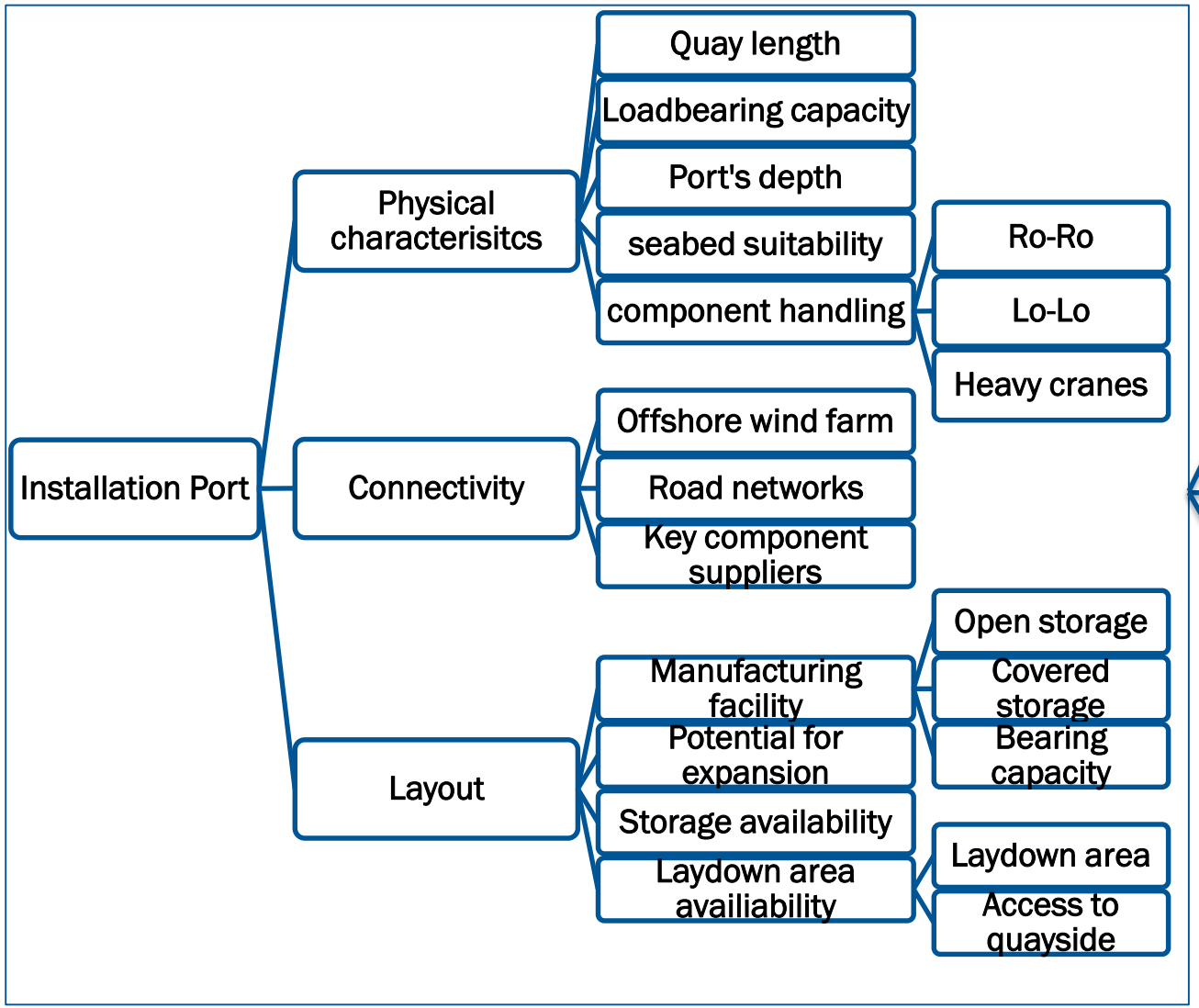
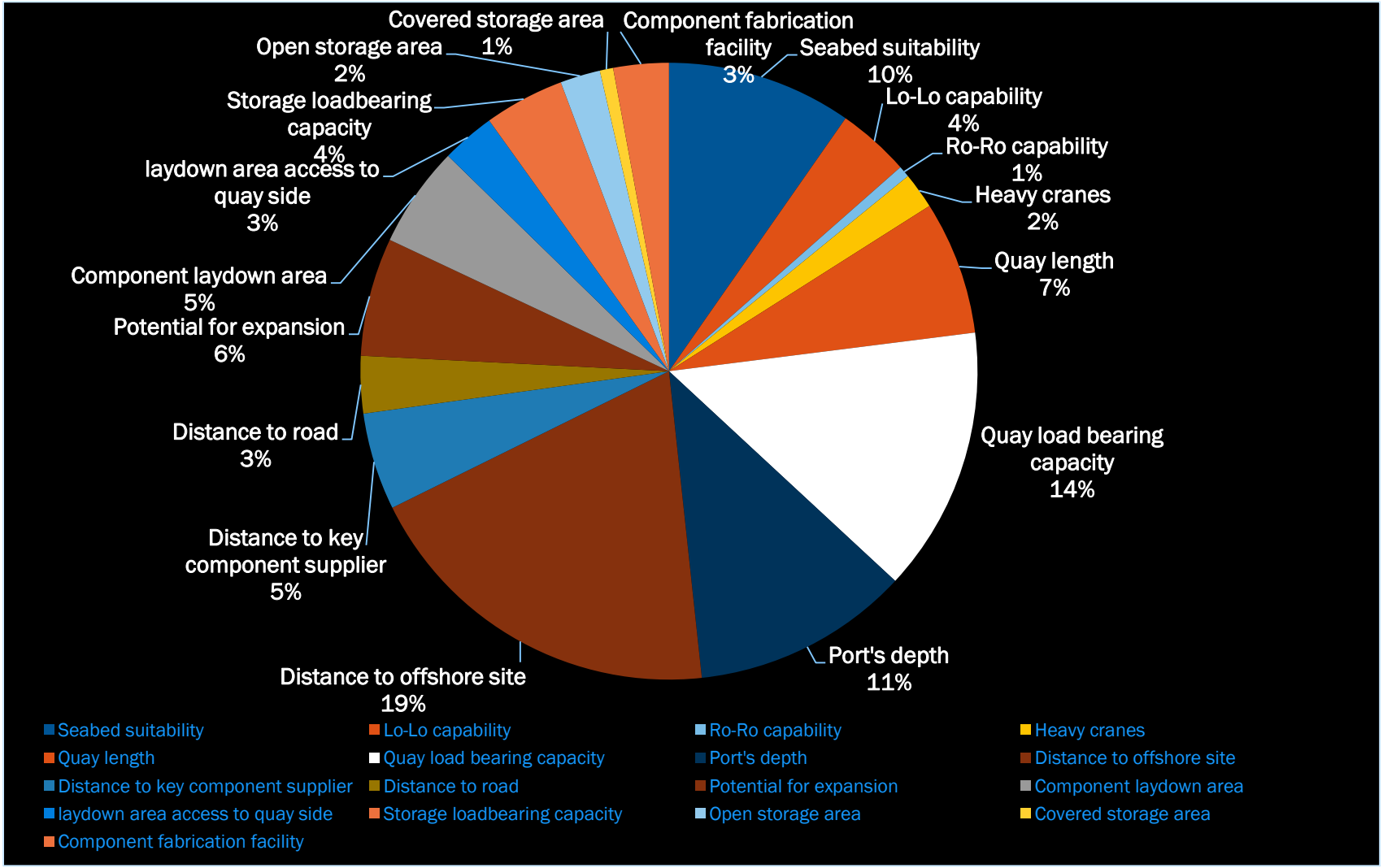
- Hierarchy models composed of different port criteria were developed.
- These models were then validated by **industry experts**.
- In order to determine the relative significance of the criteria, pairwise comparison questionnaires were sent to 5 experts in the offshore wind industry.
- The result of the questionnaires were aggregated and the final weight for the criteria was determined.

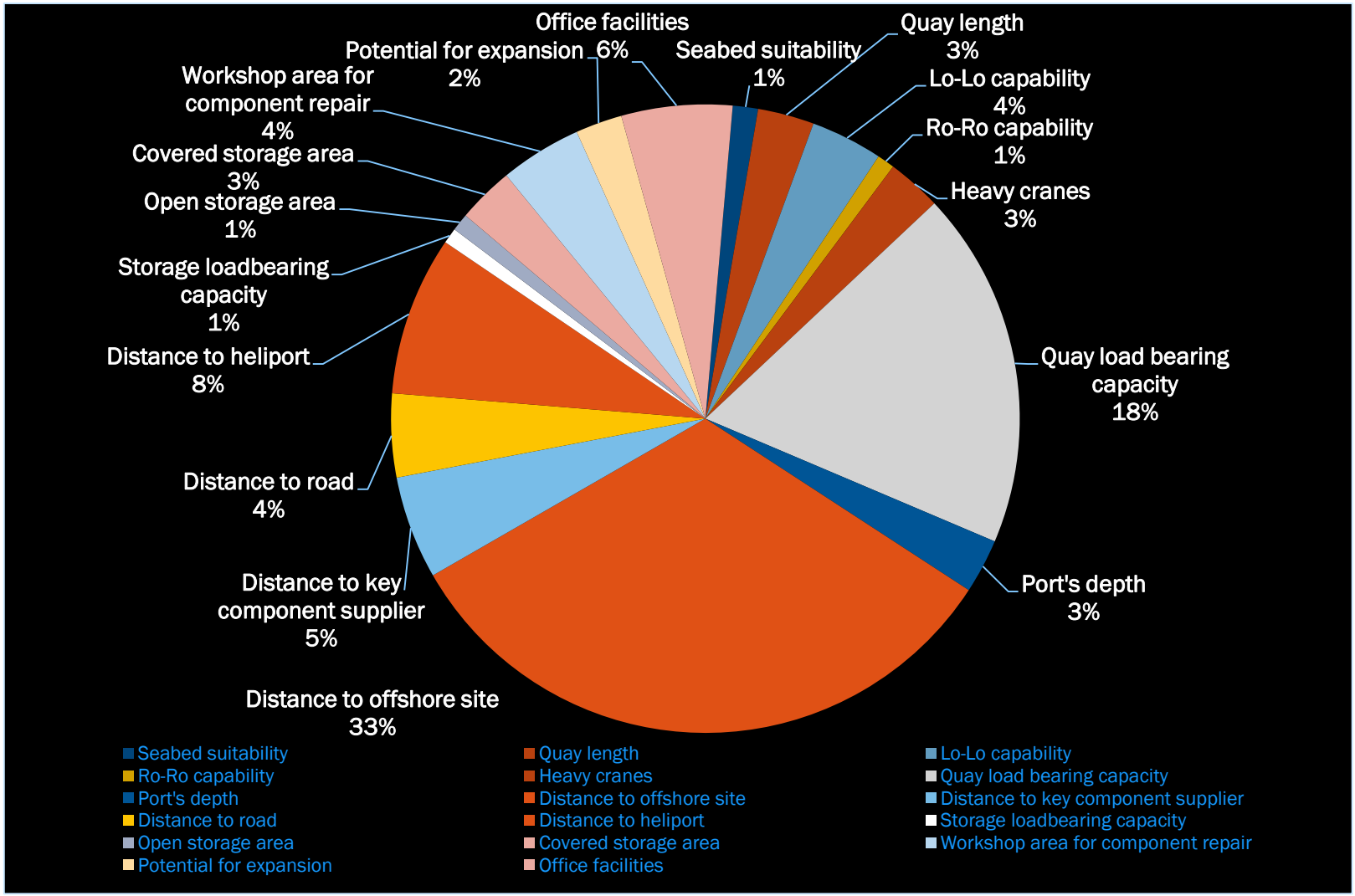
Hierarchy structure for the installation port



Installation port criteria weight



O&M port criteria weight



Example of input data for the port selection model

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Criteria	Priority Weight	Alternatives weight					Final Score = Priority weight * Alternatives weight				
		Harwich	Oostende	Hull	Able	Yarmouth	Harwich	Oostende	Hull	Able	Yarmouth
Seabed suitability	0.097	1.000	1.000	1.000	1.000	1.000	0.097	0.097	0.097	0.097	0.097
Lo-Lo capability	0.038	0.767	0.767	0.767	0.137	0.137	0.029	0.029	0.029	0.005	0.005
Ro-Ro capability	0.006	0.673	0.673	0.673	0.673	0.037	0.004	0.004	0.004	0.004	0.000
Heavy cranes	0.019	0.767	0.137	0.137	0.767	0.767	0.015	0.003	0.003	0.015	0.015
Quay length	0.070	0.200	0.405	0.959	0.359	0.384	0.014	0.028	0.067	0.025	0.027
Quay load bearing capacity	0.139	0.164	0.767	0.767	0.767	0.114	0.023	0.106	0.106	0.106	0.016
Port's depth	0.114	0.130	0.909	0.657	0.595	0.197	0.015	0.104	0.075	0.068	0.022
Distance to offshore site	0.194	0.905	0.511	0.165	0.165	0.729	0.176	0.099	0.032	0.032	0.141
Distance to supplier	0.051	0.233	0.233	0.863	0.863	0.233	0.012	0.012	0.044	0.044	0.012
Distance to road	0.030	0.312	0.963	0.347	0.347	0.304	0.009	0.029	0.010	0.010	0.009
Potential for expansion	0.062	0.303	0.322	0.368	0.963	0.318	0.019	0.020	0.023	0.060	0.020
Component laydown area	0.053	0.961	0.369	0.369	0.369	0.225	0.051	0.019	0.019	0.019	0.012
laydown area access to quay	0.028	0.363	0.363	0.701	0.920	0.110	0.010	0.010	0.020	0.026	0.003
Storage loadbearing capacity	0.042	0.327	0.963	0.327	0.327	0.327	0.014	0.040	0.014	0.014	0.014
Open storage area	0.021	0.247	0.227	0.891	0.828	0.227	0.005	0.005	0.019	0.017	0.005
Covered storage area	0.007	0.481	0.386	0.820	0.820	0.067	0.003	0.003	0.006	0.006	0.000
Component manufacturing facility	0.029	0.137	0.767	0.767	0.767	0.137	0.004	0.022	0.022	0.022	0.004
Total							0.499	0.631	0.591	0.571	0.403
Rank							4.000	1.000	2.000	3.000	5.000

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Port selection tool demo

In summary:

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- 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.

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Thank you for your attention

Q&A

Publications

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- Akbari, N., Irawan, C. A., Jones, D., Menachof, D. Port suitability assessment for offshore wind projects *Renewable Energy* (under review).

- Irawan, C. A., Song, X., Jones, D., Akbari, N. Layout optimisation for an installation port of an offshore wind farm. *European Journal of Operational Research* (accepted & under revision).