A tool to simulate decommissioning offshore wind farms

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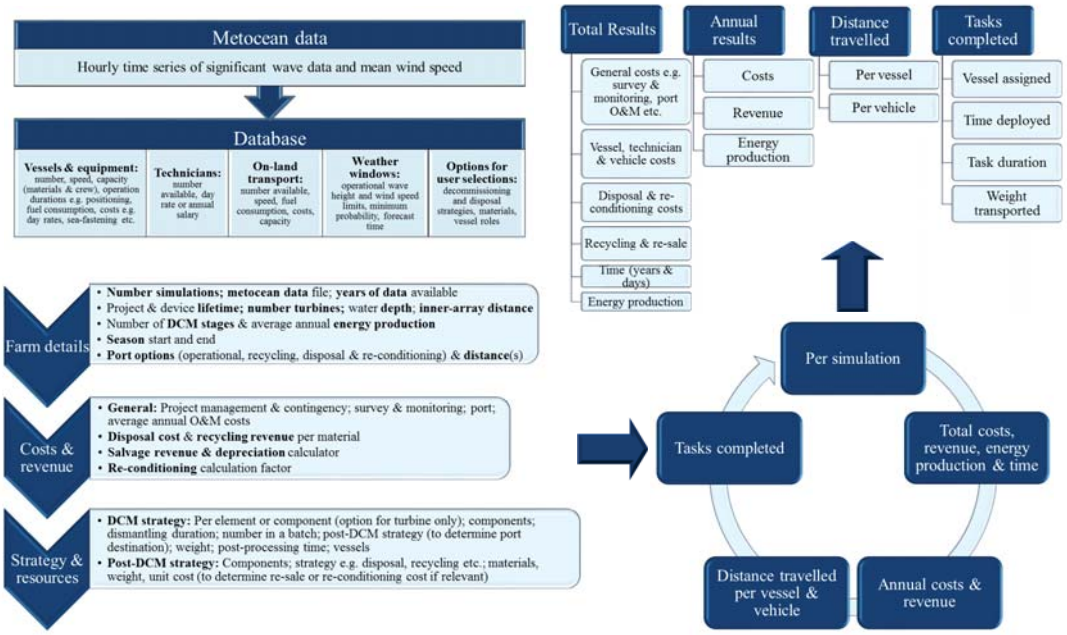
Background & Objectives

Decommissioning is an emerging practice for the offshore wind industry. Due to the lack of reliable data or experience, existing decommissioning plans are high-level estimates of the expected strategy, time required and costs. However; if underestimated, decommissioning may result in significant and unexpected outgoings at the end of a farm lifecycle. Simulation is an effective way to test a plan is both executable and cost-effective, as well as optimising activities for an individual site. Therefore, a stochastic tool was developed to simulate a wide range of decommissioning methods, using the Monte Carlo method to consider the impact of uncertain factors such as weather and costs on time and expenditure. The LEANWIND DCM model is the first detailed simulation model developed for this crucial project phase. This paper

- Describes the scope of the model (Figure 1);
- Documents a case-study to validate outputs (Figure 2);
- Demonstrates the model's capabilities through extensive sensitivity analysis (Figures 3-5).

Scope & methodology — Figure 1 Decommissioning model



Case-study

- North Sea (UK) site
- 100 × 8MW turbines & monopile foundations
- 40km from shore
- 2 jack-up vessels and 2 barge & tugs
- 72 technicians
- 10 on-land vehicles
- 1000 simulations

Table 1 — Recoverable materials: [1-7]

Component	Materials	Weight	Disposal strategy
Total rotor mass		195t	
Hub casing	nodular cast iron	90t	Recycling
Blades (3)	carbon fibre	105t	Disposal
Total nacelle mass		285t	
Gearbox		114t	Re-sale
Generator	65% steel 35% copper	114t	Recycling
Main shaft & bearings	Steel compo-nents	11.4t	Recycling
Transformer & power con-vertor		2.28t	Re-sale
Housing	fiberglass	43.32t	Disposal
Tower	Tubular steel	558t	Recycling
Monopile	Hollow steel	900t	Recycling
Transition piece	Tubular steel	300t	Recycling

Key Findings

- The model was validated against existing cost (Figure 2) and time estimates. Sensitivity analysis confirmed the tool is working as expected.
- Analysis also demonstrates how the model can identify general trends, potential time/cost savings and areas for further optimisation.
- To summarise a selection of key findings:
  - DCM took less time with more resources (vessels and technicians) and vice versa, but more in-depth analysis could examine the optimal number of vessels and technicians considering the trade-off between time and cost-effectiveness. (Figure 3)
  - Increasing operational weather limits = increased accessibility, reducing time and costs. However, this did not consider the added cost of vessels with improved capabilities. Further research could find the ideal balance within fleet in terms of vessel capabilities and cost. (Figure 4)
  - The greater the distance from shore, the fewer Weather Windows available for feeder vessels to transit to and from site, highlighting whether this strategy is effective. Further study indicates that while they saved time, the additional cost of feeder vessels could negate the benefit. (Figure 5)
  - A number of studies indicate the importance of ensuring strategies are optimised for a given farm scenario and site conditions e.g. a strategy may suit OWFs close to shore with benign weather conditions, but the optimal scenario may change further offshore in more extreme conditions.

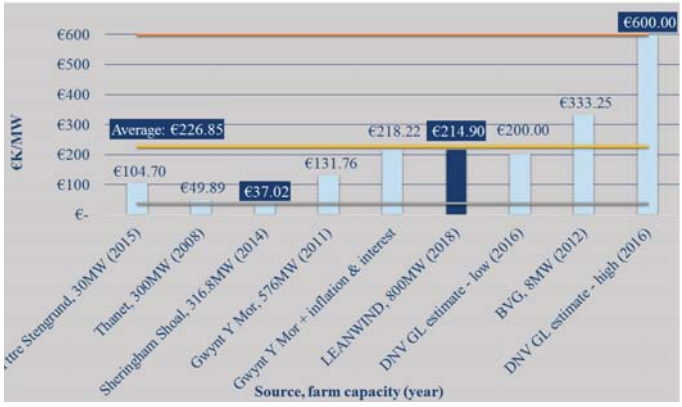


Figure 2 DCM cost comparison [3, 8-12]

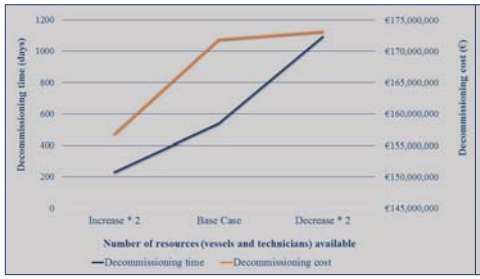


Figure 3 Number of vessels & technicians

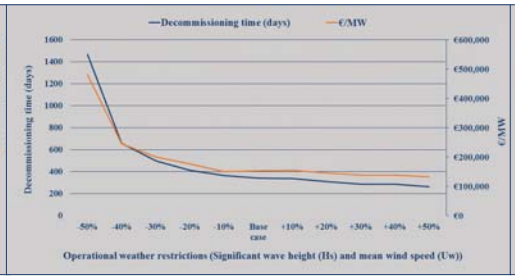


Figure 4 Weather restrictions (Hs & Uw)

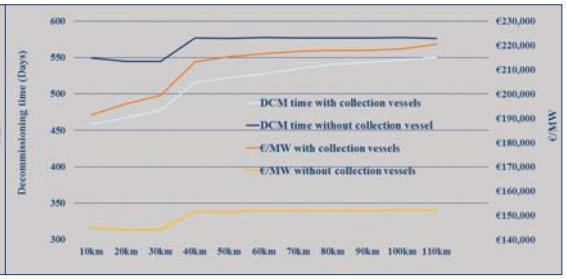


Figure 5 Distance from shore - with and without feeder vessels

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