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REDUCING THE COST OF OFFSHORE WIND CONSTRUCTION

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RES-OFFSHORE

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Abstract

Construction represents one of the major cost elements for offshore wind projects. This is exacerbated by weather delays, which can as much as double the installation costs. Reducing cost, mitigating and contingency planning for offshore construction is therefore a key target in order to reduce the levelised cost of energy for offshore wind and to make it a more competitive energy source.

The work presented here aims to capture lessons learnt from installation optimisation studies carried out on a number of projects, and to reflect on how the industry can build on this experience to reduce the cost of offshore wind project construction.

While working on projects in the past, RES has developed a software tool that specifically works in the time domain and enables us to estimate construction durations that incorporate the complexities of site conditions and the installation operations: the CORE model. CORE was coupled with in-house installation expertise in order to define the optimum installation strategy for a number of projects. In the current work, we decided to take a broad view of past projects in order to reach conclusions/recommendations that would support the cost reduction across the industry if applied to future projects.

Existing technologies: it was found that the overall construction strategy should be well optimised during the project development and until/during construction, using a methodology that retains the specificity and complexity of the site conditions and of the installation sequence. What may seem like a small optimisation on paper, may save millions at a given site.

- Future technologies: focus should be put on suppliers delivering vessels with improved capability that can operate in tougher weather conditions. It is possible for suppliers to target given thresholds that will save on offshore construction while not being overly costly to build.

Objectives

The main objective of this work is to evaluate how the cost of installing an offshore wind farm can be reduced, thus contributing to making offshore wind a more competitive energy source.

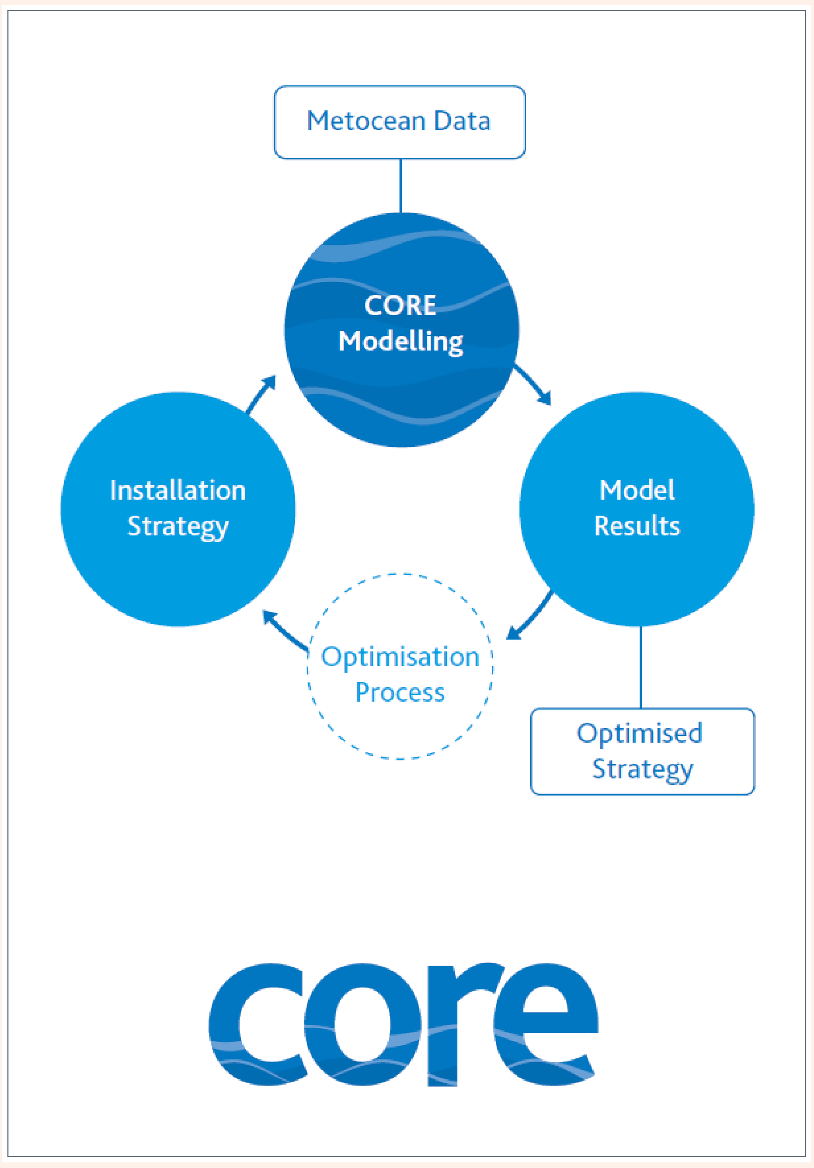
The work presented here is based on experience acquired during the development and construction of a number of projects, in various Metocean environments: the English Channel, the Irish Sea, and the North Sea.

Methods

Different installation strategies were assessed with CORE (Construction Offshore Risk Estimator), a numerical simulation model developed in-house.

CORE facilitates:

- Vessel selection
- Port selection
- Definition of construction sequence
- Identification of bottlenecks in installation
- Targeted equipment investment
- Contract negotiation: for example pricing weather risk
- Budgeting and contingency assessment
- Operational planning and "what-if" scenarios



The model simulates the installation for a list of starting dates, generating a population of results.

The inputs are:

- Installation sequence: detailed sequence of operations, including their duration and operational weather limits
- Weather data: time series of Metocean parameters, typically including significant wave height, current speeds and wind speeds

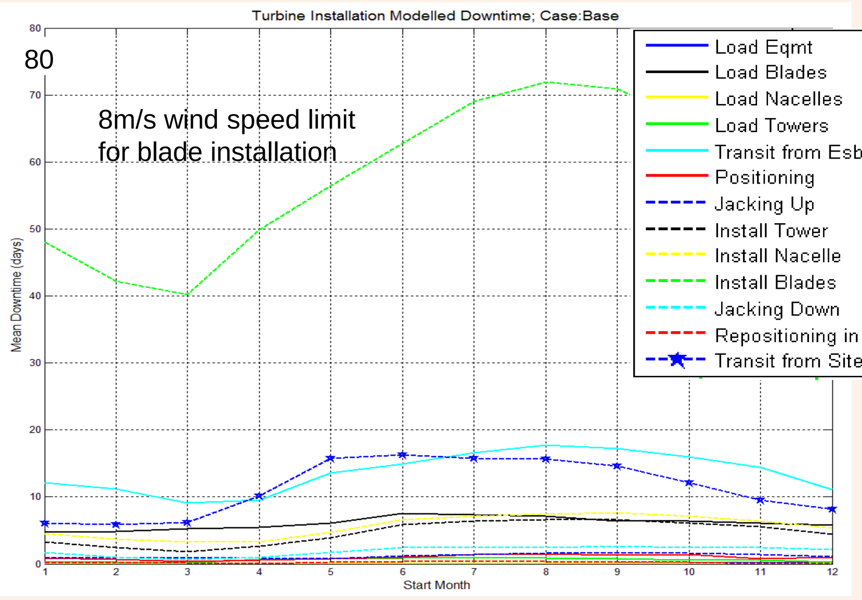
The model analyses the population of installation simulations in the time domain in order to output, for a range of probability levels, total installation durations as a function of starting month, monthly overall weather downtime, and average weather downtime per operations.

CORE has been validated against downtime data collected by RES during the construction of wind farms.

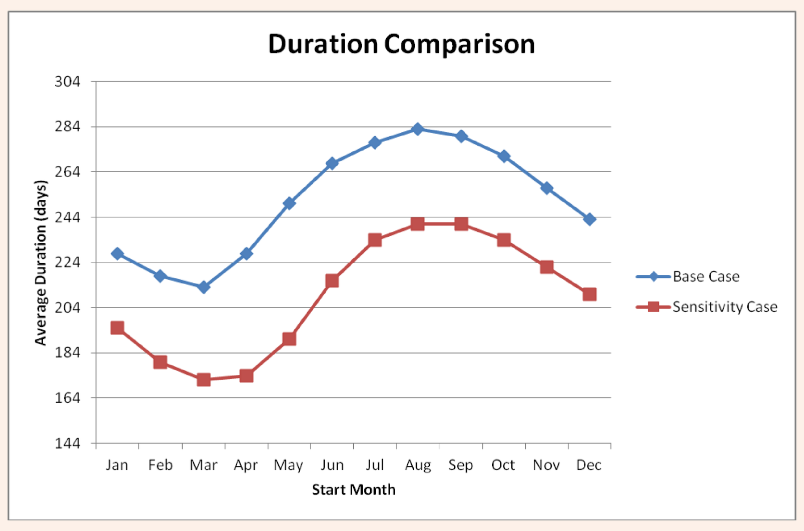
Cost savings with existing technologies

The installation of wind turbines are here used as an example to demonstrate how installation bottlenecks can be identified and removed.

Initially, the installation sequence was modelled by assuming that the crane to be used could only operate in wind speeds of up to 8m/s (basecase). The model highlighted that the main bottleneck during the installation would be the blade installation, generating in average between 40 and 73 days of downtime, depending on the month when the installation starts.



In order to remove this bottleneck, the retrofitting of the crane was considered, in order to allow it to operate in wind speeds of up to 12m/s (sensitivity case). The CORE simulation showed that this seemingly small optimisation could reduce the overall installation of the turbines by as much as 40 days, thus a saving of the order of £10 million for a project of 75 turbines..

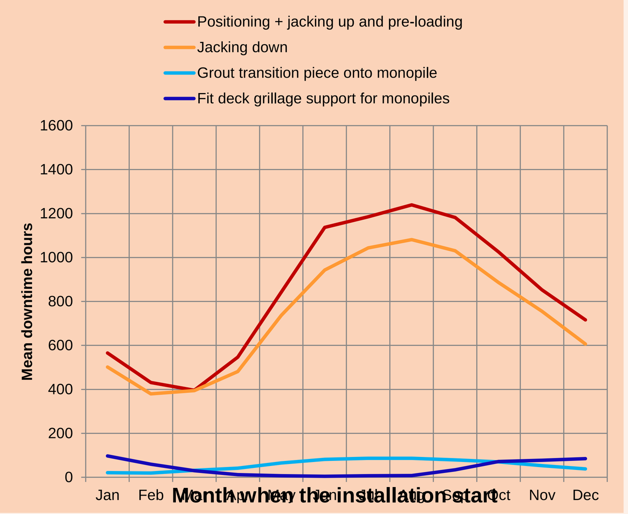


On another project, operations requiring Remotely Operated Vehicles (ROV) were initially assumed to be possible in current speeds of up to 0.8m/s (~1.6knots). Current speeds at the site were strong, with peak spring current speeds frequently reaching 1.5m/s (3knots). The use of ROV operating in current speeds of up to 1.2m/s was showed to significantly reduce the expected installation durations.

A number of sites in the North Sea, English Channel and Irish Sea see strong current speeds, and our work on these sites has highlighted that tidal currents as an operational constraint should not be neglected when estimating installation duration. The use of a model in the time domain was found to be necessary for sites with strong tidal currents, due to their periodicity.

Cost savings with future technologies

The installation of most wind farm elements requires the use of a jack-vessel: wind turbines, foundations, offshore substation. In particular, we consider here the installation of monopiles and transition pieces. Jacking up and down operations were found to be those generating the most downtime.



This is seen as a bottleneck that can only be removed by using new vessel designs. For example, semi-submersible vessels and monohull crane vessels, currently used in the oil and gas industry, could be modified in order to respond to the offshore wind industry's need. The LEANWIND project is also considering new vessel designs. Using a tool such as CORE, it is possible to explicitly describe improvements that need to be made, as it can quantify the potential cost savings.

Conclusions

The optimisation work carried out for a number of sites, and all components of the wind farm has led to recommendations that developers, and the industry in general, should consider:

- The overall construction strategy should be well optimized during the project development and until/during construction, using a methodology that retains the specificity/complexity of the site conditions and of the installation sequence. What may seem like a small optimization on paper, may save millions at a given site.

- Focus should be put on designing new vessels that can operate in tougher weather conditions. It is possible to target given thresholds that will save on offshore construction while not being overly costly to build.

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