Offshore wind: unlocking value across the project lifecycle

ONYX Insight has been working with offshore asset owners and operators since 2010 and has witnessed firsthand the tremendous progress made by the sector. Yet, despite these achievements, there is still untapped potential that can be deployed today for further operational improvements. This article highlights the best practices learned and how technology can significantly increase value at every stage of the offshore project lifecycle.

The rapid growth of offshore wind power has encountered some turbulence in recent times. The industry has been grappling with the macrotrends of rising interest rates, slow regulatory evolution, and strained supply chains. This has prompted some organisations to either downshift their pace, holding out for more favourable economic conditions, or to become increasingly selective regarding their ventures and targeted regions.

For those who persevere, tapping into the still considerable potential of offshore wind, a common theme is clear: the necessity to drive efficiencies across the whole project lifecycle.

Optimising development through early adoption of condition monitoring technology

Success in offshore wind farm development depends on the ability of the developer to accurately predict the reliability and performance of new turbine technologies with little or no track, or even those that are still in a prototype stage. It's not the only factor but one of the significant variables that can determine project profitability, bid competitiveness and operational confidence. Implementing a comprehensive condition monitoring strategy from the project's inception aligns projections with real world outcomes, mitigates uncertainties associated with turbine technology, and enhances the project's financial viability.

Risk mitigation and OPEX optimisation

All modern offshore turbines are supplied with drivetrain condition monitoring systems. By extending traditional CMS capabilities beyond the drivetrain to other critical components, including blades, pitch systems, and towers, developers can minimise risks associated with new turbine technologies even further.

It is important that such systems are tailored to specific turbine technology, minimising the risk exposure during the operational stage. For example, integrated drivetrains have superior alignment between different components compared to modular designs but present challenges during maintenance as an entire unit will have to be craned down for maintenance.

To improve operability, augmenting such designs with additional predictive technologies will enable more accurate diagnostics and proactive, smaller scale interventions instead of expensive major component replacements.

The next step is to couple such advanced detection with engineering solutions to extend components' remaining useful life, such as targeted derating and tactical repairs. By including such scenarios in OPEX modelling, developers can find the most cost effective condition monitoring strategy for their project and develop nuanced OPEX projections more reflective of realistic operational scenarios.

Not only do such dynamic models detail multiple scenarios to answer questions from lenders or other stakeholders, but they are also a must for offshore sites that have access constraints.

By utilising data from multiple turbine components and implementing targeted maintenance strategies, developers can optimise major interventions, reducing O&M costs and maximising production uptime. This data driven approach facilitates operational planning, ensuring investors' confidence, cost efficiency and enhanced reliability performance throughout the project lifecycle.

Operational planning precision in floating wind

Floating offshore comes with additional operations and maintenance complexities, from the costs and downtime linked to the tow-to-shore strategy to the intricate relationships between turbine and floater OEMs. There are early signs that turbine OEMs are also more reluctant to provide a similar level of contractual coverage as they have historically for fixed foundations. While in the case of major component replacement, are seeking to cover the cost of replacement components only, excluding the substantial cost of performing the replacement.

Through the proactive deployment of advanced monitoring systems, developers and asset owners can minimise operational disruptions and execute targeted maintenance actions, achieving realistic and competitive financial performance with new floating technology.

End of warranty campaigns: ensuring no costly surprises ahead

As offshore wind projects reach the critical milestone of the End of Warranty (EoW), asset owners are tasked with conducting a comprehensive assessment of the wind farm to safeguard against inheriting potential reliability issues. This phase demands a thorough sweep of the assets to ensure continued operational excellence and mitigate unforeseen risks.

Traditionally, this process has been time consuming and resource intensive, relying heavily on physical inspections as the primary source of information. However, ONYX uses a proven approach ideal for the large, complex turbines of today with data driven methodology at its core. By commencing with meticulous data analysis to identify a targeted subset of turbines for detailed inspections, the company effectively streamlines the process, resulting in substantial time and cost savings.

Furthermore, this innovative approach significantly enhances the accuracy and efficacy of the entire inspection, ensuring that no potential issues are overlooked. In a recent EoW campaign undertaken by ONYX off the coast of Belgium, the project achieved successful resolution in half the time and at 60% of the cost of traditional EoW campaigns.

Achieving O&M excellence: unlocking value with predictive analytics

The industry has achieved significant strides in reducing LCoE, primarily driven by the rapid increase in turbine size. While reductions in the cost of energy have been instrumental in the accelerated adoption of offshore wind technology, it has also masked many inefficiencies still present in offshore operations and maintenance. As an entire sector finds itself in search of profitability, now is a good time for disciplined implementation of predictive technologies that improve planning and eliminate waste.

Intelligent scheduling to reduce costs and avoid vessel bottleneck

A detailed analysis of selected UK offshore wind farms using 4 MW turbine technology indicated an average of 1.4 jack-up deployment campaigns per year. This number is expected to increase for newer, larger turbines due to higher major component failure rates and longer replacements. Offshore asset owners are now focusing on streamlining major maintenance activities to once a year, supported by predictive maintenance technologies.

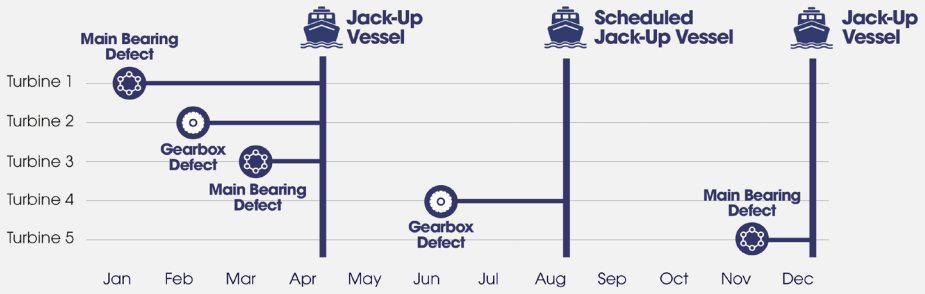
The availability of service vessels is becoming a significant challenge in offshore operations and maintenance, particularly for larger turbines that require larger vessels and more complex replacement procedures, emphasising the importance of intelligent scheduling. By leveraging advanced detection capabilities and engineering solutions, ONYX's approach to intelligent scheduling optimises offshore wind farm production and reduces operational expenses. This method extends components' lifespan through targeted strategies, resulting in cost savings and minimised production losses.

Strategy 1

Replace at first opportunity
x3 jack-up vessel interventions

Additional Vessel Cost **£1m**

Additional Lost Production **£0m**

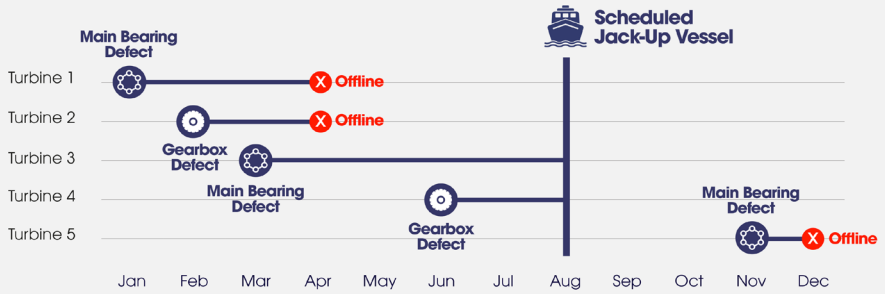


Strategy 2

Run to failure, replace when scheduled
Only fix during annual jack-up campaign planned for August

Additional Vessel Cost **£0m**

Additional Lost Production **£1.3m**

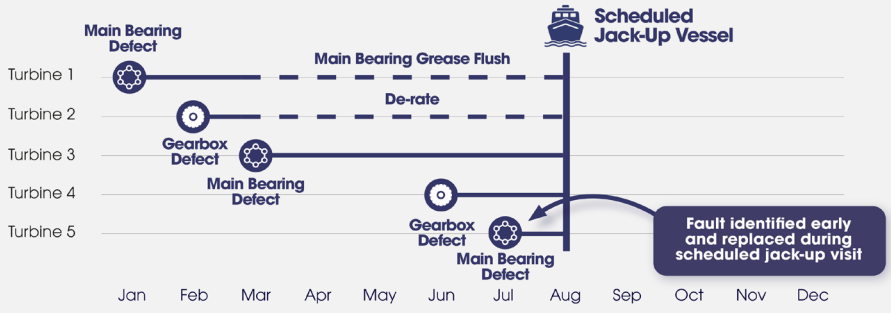


Strategy 3

Optimise with advanced detection
Alongside de-rating & main bearing grease flushing to extend useful life.

Additional Vessel Cost **£0m**

Additional Lost Production **£0.2m**



Consider the following scenario. At the start of the year, an offshore wind farm schedules a single jack-up campaign in advance for July to August. The farm experiences two gearbox and three main bearing failures across five turbines. The operator has three strategies; replace at the first opportunity, run to failure or optimise with advanced detection; for managing defects around the scheduled jack-up interventions, which results in additional vessel costs and lost production (see above).

Strategy three is the most effective because it deploys advanced analytics to scan asset health ahead of time, identifying all defects and their progression, including a main bearing defect that in another strategy may not have been apparent until after the scheduled maintenance, to optimise production and maintenance schedules.

By utilising the remaining useful life projections of damaged components to deploy targeted de-rating and main bearing grease flushing developed by ONYX, additional costs are limited to £200k. A saving of £800k compared to strategy one, 'replace at the first opportunity', and £1.1m against strategy two, 'run to failure'.

Filling the knowledge gap with portable sweeps

When it comes to gathering data efficiently without relying on lengthy IT infrastructure setups, portable measurement systems emerge as a valuable tool. These systems excel at acquiring data quickly, making them ideal for conducting rapid site assessments on target components not covered by permanent condition monitoring systems, such as pitch bearings and blade root connections.

ONYX's ecoPITCH is a portable measurement system that offers a practical engineering solution that allows renewable energy asset owners and operators to quickly assess the condition of specific components for prioritisation of maintenance activities or to quantify potential risk exposure following a catastrophic failure.

The simplicity and ease of use of portable measurement systems make them an attractive option for site assessments, giving operators the data to optimise maintenance campaigns. They are especially valuable for components that cannot be easily inspected, providing a consistent data set to support maintenance decisions.

Strengthening offshore wind industry fundamentals

In a tightening offshore wind market, the industry stands at a crucial juncture to drive down costs and boost profitability. While the prevalent practice of relying on OEMs for condition monitoring is cost effective, the ONYX experience shows that implementing strategic, data driven approaches will amplify offshore wind farm performance and longevity.

The industry faces a pressing need to rectify inefficiencies masked by the recent surge in turbine size. The next 12 to 24 months offer a pivotal window to strengthen foundations, recalibrate strategies, and pave a sustainable trajectory ahead. Amid the industry's path to profitability, proactive maintenance tactics and advanced predictive technologies are imperative for sustained success.

By shifting from manufacturer focused models to independent, data driven maintenance strategies, operators can enhance turbine reliability, optimise operational costs, and significantly reduce CO_2 emissions through increased parts reuse. Adjusting to the current less favourable macro trends will empower the offshore wind industry to fulfil its ambitious objectives while delivering resilient performance and profitability.

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