

WHITE PAPER

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# How Robust O&M Plans Boost the Profitability of Offshore Wind Farms

The importance of effective digitally-backed O&M execution as the sector aims to reach over 350GW installed capacity by 2028.

Companies are under pressure to run operations and maintenance (O&M) at offshore wind farms more efficiently to deal with larger turbines, skills shortages, and complex handover processes. We look at the O&M challenges that owners face as they build, commission and operate projects – and how digital tools can drive improvements.

**FOCUS: Reducing time to repair/Minimize production losses**

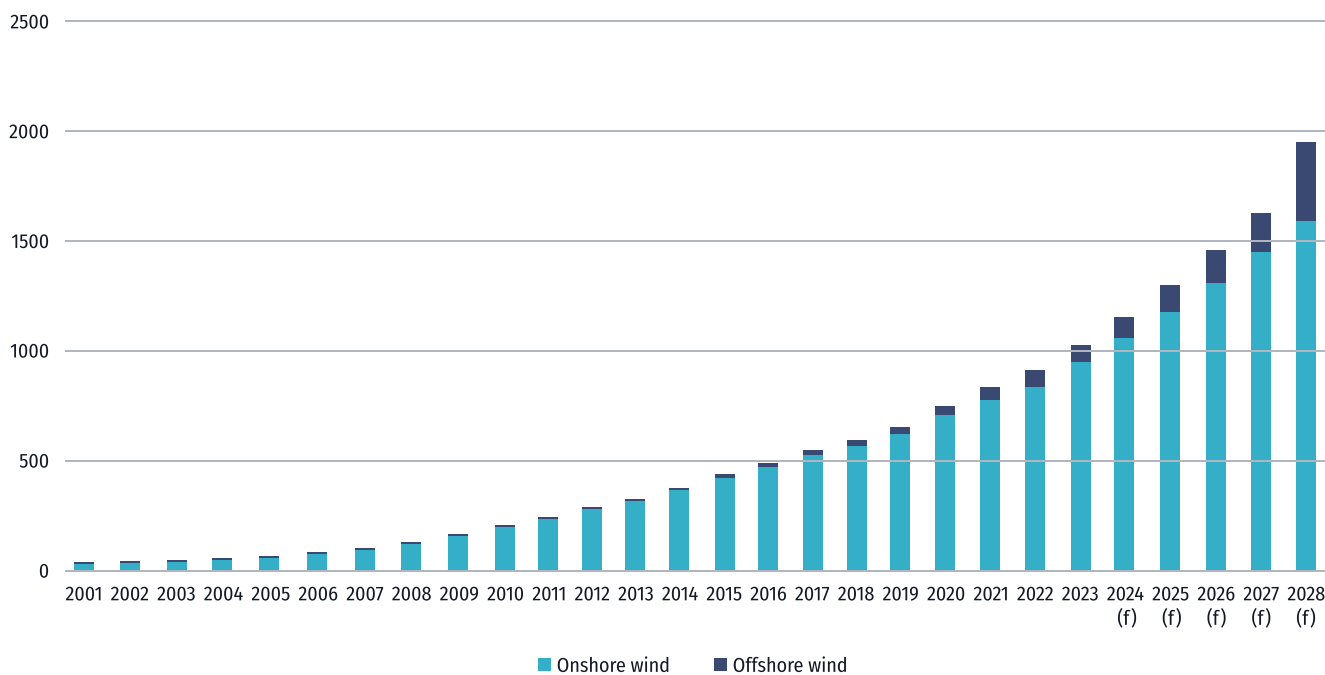
The wind sector has enjoyed a decade of remarkable growth. The headline capacity of operational wind farms has tripled to over 1,000GW in the last decade, and that is predicted to nearly double again over the next five years (See graph below).

Offshore wind is still a relatively small proportion of that, totalling 75GW at the end of 2023, which represents 7.3% of the 1,021GW of wind farms installed worldwide. But the Global Wind Energy Council (GWEC) said that will increase fivefold to 359GW by 2028 and offshore wind will account for 18% of installed wind capacity.

Developers and operators in offshore wind will celebrate how the industry is making a bigger contribution to the energy mix. But such growth brings challenges for effective operations and maintenance (O&M) at offshore wind farms.

If that prediction is correct, 284GW of offshore wind farms will come into operation in the next five years alone. This rush of development will put strain on owners to bring projects into operation quickly and run them profitably from day one. It will also show up pitfalls in how many operators develop operations and maintenance (O&M) plans. Robust O&M plans are important to run offshore wind farms profitably.

**Total installed wind capacity globally (GW)**



Graph 1: Headline capacity of operational wind farms to double over next five years. Source: Global Wind Energy Council

A thorough approach to O&M is also needed for operators who need to profitably run the growing numbers of older offshore wind farms. There are now more than 8GW of offshore wind farms that are more than ten years old, and that figure will triple in the next four years. These assets will need more hands-on maintenance work than new schemes, and this work must be underpinned by smart data-driven O&M systems.

Finally, some organisations are warning that operators’ ability to deliver efficient O&M plans will be hindered by the shortages of skilled technicians and supervisors.

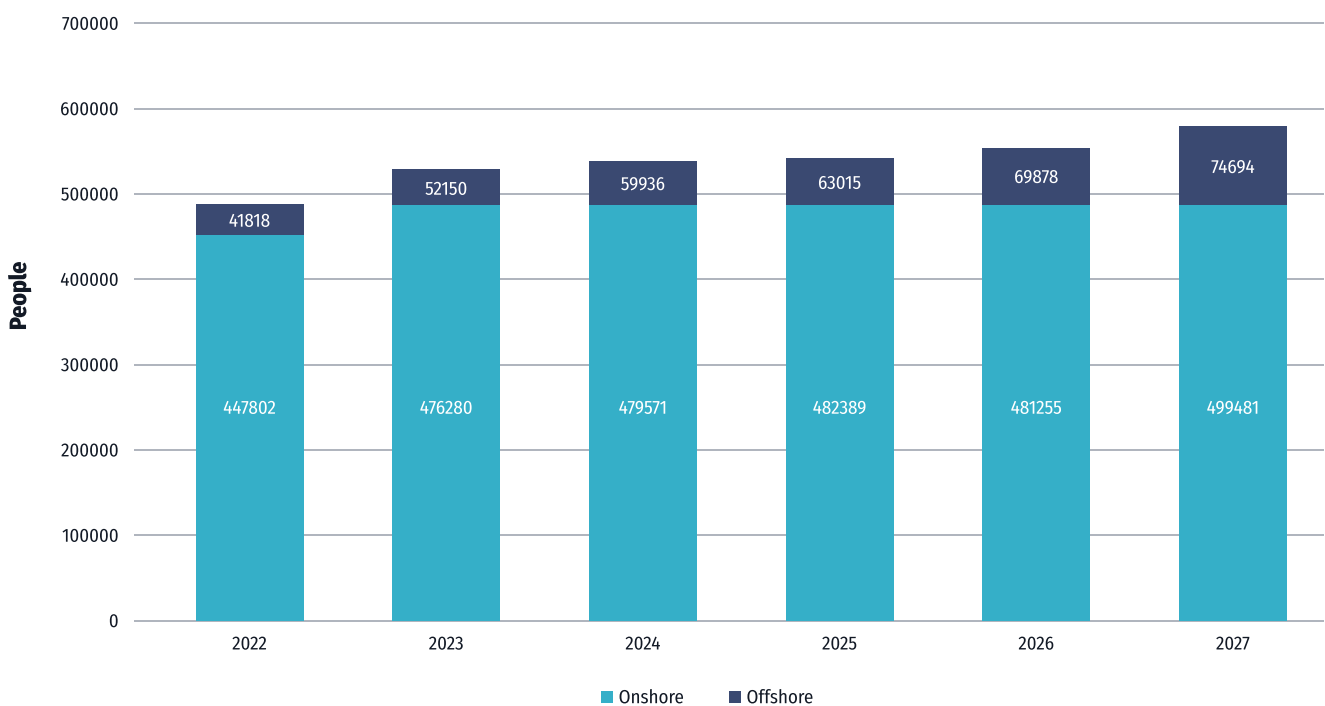
In October 2023, GWEC and the Global Wind Organization said in their ‘Global Wind Workforce Outlook’ that the number of technicians needed in offshore wind needs to grow 43% from around

52,000 in 2023 to almost 75,000 in 2027 (See graph below). This includes people working in construction and installation (C&I) roles as well as O&M, but there is a concern that these targets will not be met and that O&M could suffer.

In this white paper, we look at the market challenges that will necessitate a greater focus on robust O&M planning by offshore wind farm owners and operators; where we see current shortfalls in how O&M is planned and carried about through project construction and into operations; and how the right digital systems can help.

The growth of offshore wind is undoubtedly an exciting opportunity for operators and investors, but they can only take full advantage if they approach O&M smartly.

**Global wind workforce needs in C&I and O&M (2022-2027)**



Graph 2: Number of technicians needed in offshore wind needs to grow 43% from 2023 to 2027. Source: Global Wind Energy Council





# Offshore wind O&M and technology challenges

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Offshore wind is growing globally, but the companies developing and operating these projects are also under pressure because of squeezed profit margins.

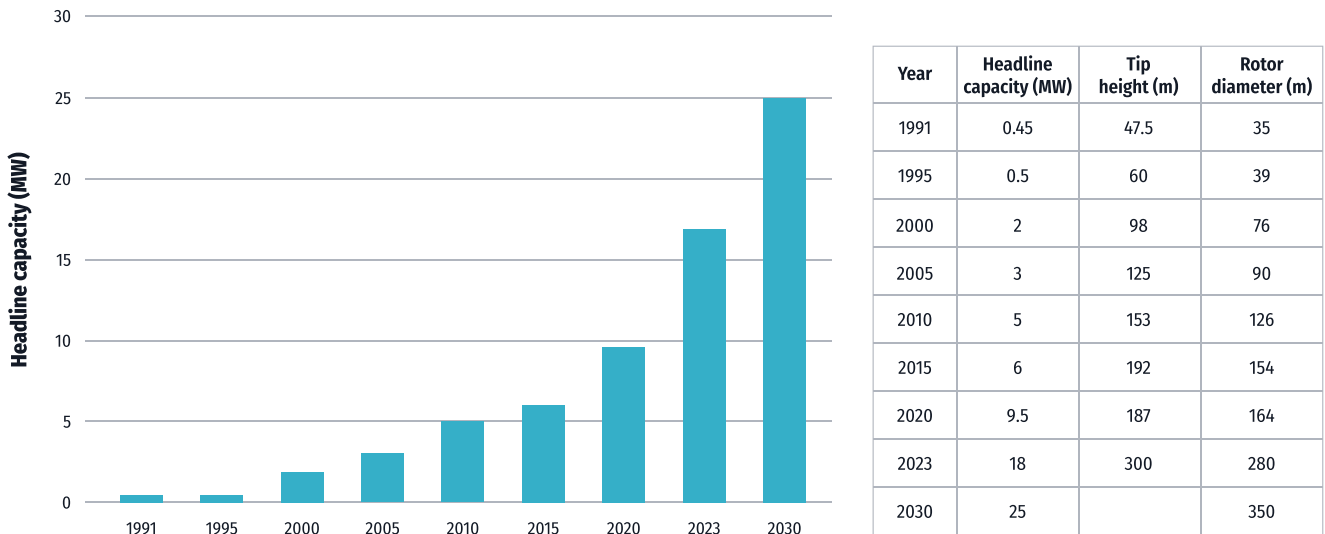
Over the last decade, there has been a ‘race to the bottom’ in offshore wind to deliver projects at the lowest prices possible. That has put pressure on operators to run their assets as efficiently as they can, including in the operational phase. But, since 2022, that strain has increased as operators have had to cope with inflation, including rising costs for wind turbines, raw materials, workers, and the debt needed to fund projects.

This means operators must work hard during construction and operations to ensure they are spending money as efficiently as they can. That relies on smart O&M plans.

Here are some key technology challenges that impact on O&M planning:

- **Larger offshore wind turbines:** In 2000, the largest offshore wind turbines had headline capacity of just 2MW each, and the figure was 6MW just ten years ago (See graph page 5). This has grown to 18MW in 2023 and could hit 25MW by 2030. This is a big O&M challenge for owners because a single turbine failure is now more costly than it would have been previously; and because the race between turbine makers to launch more advanced machines can introduce problems too.
- **Impact of larger turbines on balance of plant:** Larger turbines and projects need bigger foundations, monopiles, substations and cables, and managing this infrastructure – the ‘balance of plant’ (BOP) – is the owner’s responsibility from day one. This means the owner’s O&M plan for the BOP must work seamlessly with how turbine original equipment manufacturers (OEMs) are looking after the turbines through the servicing contracts that come into force after installation.

### Size of largest offshore wind turbines (1991-2030)



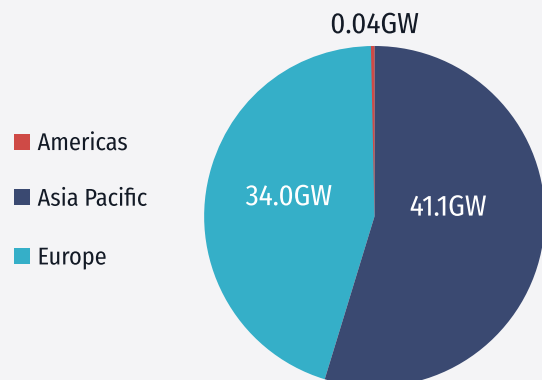
Graph 3: Offshore wind turbines headline capacity grown from 2MW in 2000 to 18MW in 2023.  
Source: Global Wind Energy Council

- Service deals ending for older turbines:** Over 8GW of offshore wind farms are more than ten years old, which means owners of these assets need O&M plans that can cope with the technical issues that often come with older machines. On top of this, owners may have to manage these older turbines themselves if their initial service deal with the OEM comes to an end. However, one benefit for these older projects is at least many benefited from larger public subsidies.
- Global variability in site and climate conditions:** The offshore wind sector is now established in northern Europe and China (see graph 4), and is expanding beyond these heartlands. Operators must be aware of how projects in different countries can face different technical challenges, and their O&M plans need to reflect this. In addition, there can be big differences in how offshore wind farms are built and operated in different regions, and the availability of local skills.
- Ongoing construction challenges at operational assets:** Owners are exposed to construction challenges at offshore wind farms even if a project is operational.

They need to inspect, service and carry out other necessary work, which means their O&M plans can be affected by typical construction issues such as weather windows, vessel availability, port infrastructure, and access to technical staff.

In short, owners face a wide range of challenges to deliver O&M plans that enable them to run offshore wind farms profitably in an era of squeezed profit margins. But improvements are needed in the industry’s approach and attitude to offshore O&M.

### Total installed offshore wind capacity in 2023 by region (GW)



Graph 4 - Source: Global Wind Energy Council

# How to deliver robust O&M plans in offshore wind

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It is important to have an O&M plan that factors in the complexities of major offshore wind farms, but operators can be smarter in how they deliver these plans.

One asset management expert we spoke to, said owners must be proactive and develop high-quality O&M plans before a wind farm is commissioned, but this does not happen “nine times out of ten”. This means owners and operators do not get in-depth insights needed to show where problems occur.

Here are four tips for how owners can develop these plans while avoiding common pitfalls:

## **1. Align your O&M plan with your partners' plans.**

It is essential to get different partners working together. If an OEM is managing O&M for the turbines and the owner is managing O&M for the BOP, these plans can come into conflict. It is important to remove adversarial relationships between parties.

Over the last decade, turbine servicing deals have moved from being based on time-based availability to production-based availability, and some are moving to revenue-based availability too.



This reflects the fact that some downtime is more costly for the owner due to fluctuations in power prices and wind speeds. But a strict focus on availability numbers can lead to conflicts in O&M.

One experienced asset manager told us that OEMs “often see the contract in terms of penalizing them” for falling short of promised availability figures, which means they can be unwilling to adapt their O&M plan to take into account the owner’s O&M plan. He said: “The first thing the OEM says is, ‘You’re going to ruin my availability if you don’t let me plan by myself.’”

However, this does not have to be an issue as owners and OEMs are ultimately after the same thing: higher availability and higher returns. This is where it is important for owners to have experienced O&M professionals on their teams, who have previously worked on comparable projects, and to also help to develop new technical staff.

## **2. Ensure your O&M plan kicks in before commissioning**

With the headline capacity of many offshore wind projects now approaching or even exceeding 1GW, owners must ensure their O&M plan take into account the work that needs to happen before a project is fully commissioned. Contractors are often under pressure to move to other projects, which can come at the cost of a smooth handover. Furthermore, there can be a major overlap between the construction and operational phases at larger projects. At projects with 100 turbines and 100 monopiles, the owner has to carry out O&M on the turbines completed early in the construction cycle while the contractor is building the later turbines.

The O&M plan must factor in this overlap and recognize that handover is a process that can happen long before completion.

“You’ve already got those ones you’ve put in that need looking after. You need the staff, and how do you look after them? You need to make sure that you plan during construction through commissioning and to handover,” one asset manager said.

The aim of an effective O&M plan is to enable the owner to build a full picture of the health of the equipment, so they can anticipate problems and minimize the cost and disruption of delays. Therefore, it is helpful that they are mindful of O&M through the process life cycle, and don’t simply have a plan that starts after final commissioning.

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### 3. Use systems to track work quality and turbine performance

Owners can more effectively deliver their O&M plan when it is based on systems that achieve the twin aim of informing them about how an asset is performing; and helping them understand the quality of the work being carried out on their projects. It is only by doing both that owners can ensure their O&M plan is fit for purpose.

For example, owners would tend to assess the quality of technical work carried out on projects by checking how many hours have been worked. But this needs to be cross-referenced against the data for how the equipment is performing, so owners get a good idea of the competence of the people who are carrying out O&M work.

Such in-depth plans enable owners to see how their turbines are performing against industry standards for that turbine platform, as well as other turbines at their projects. This information empowers owners to fix short-term problems while also making long-term decisions that affect how time- and cost-intensive their O&M plans are.

By building up a long-term picture of how the asset is performing, owners can make informed decisions about how to manage projects at their end of their life cycle.

For example, this may show if owners are inspecting turbines and other equipment too little or too much. Owners may inspect turbines regularly soon after a project is commissioned but then see this does not need to be done as regularly. Similarly, for BOP, they may realize they only need to check one-fifth of their turbine foundations each year to identify problems, rather than inspecting each foundation every year.

By building up a long-term picture of how the asset is performing, owners can make informed decisions about how to manage projects at their end of their life cycle. It is often the turbine that is seen as the primary concern in these decisions, but owners need an accurate picture of the health of their BOP too before they decide whether to extend the life of an offshore project beyond the 25 or 30 years originally envisaged.

### 4. Adapt your O&M plans for different geographies and cultures

Offshore wind developers building projects in Taiwan have faced delays to building schedules because of the different seabed conditions there as compared to offshore wind's heartland in northern Europe. This is just one example of how owners must be aware that O&M plans that work in one geography may not be easily transferable.

The offshore wind supply chain is also more advanced in established markets too, which can affect how quickly and effectively contractors can respond when work is needed at offshore wind projects. A lack of experienced contractors and logistical difficulties in some parts of the world would make it tougher for an owner to deliver an effective O&M plan in a new market, for instance.

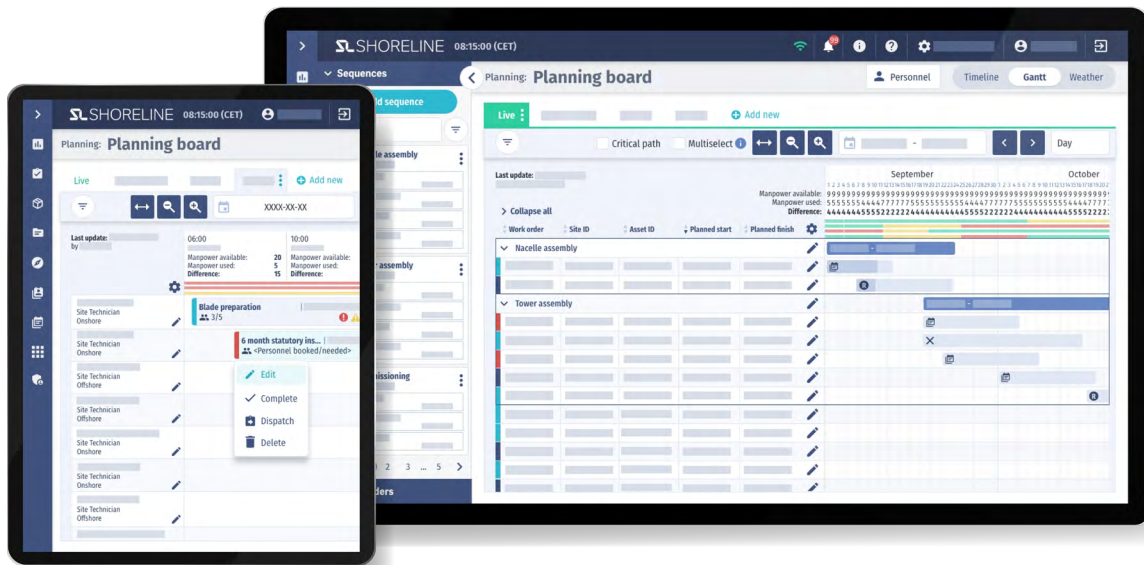


Finally, companies can operate differently in different cultures. In some parts of the world, it can be more difficult for those lower in a company hierarchy to challenge the decisions of those in more senior roles. In offshore wind O&M, this could translate to a hesitancy among those in lower levels to challenge agreed project plans.

But this is one area where a digital O&M platform can empower professionals. Such platforms can provide key evidence of how a project is performing and the O&M work needed to help a project achieve its full potential. Such data can make it easier for O&M professionals to show in an objective manner what needs to be done.

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# New digital systems can support robust O&M

Companies in the offshore wind industry need to make progress in how they develop their O&M plans, but there are software platforms that help them do so. These help provide owners and operators with the detailed picture they need about their assets.

Ole-Erik Endrerud, CEO and founder at Shoreline Wind, said that owners are under pressure to run assets profitably because of the impact of competitive tenders.

He said: “You have to operate your assets stringently or you’re going to lose a lot, and the financials of these sites are quite dependent on it. We’re away from all of the old sites having very high feed-in tariffs, so there’s a substantially higher pressure on operations.

It’s just got to be more efficient.”

Endrerud said there were three main types of digital technology that owners should have in their toolbox to help them develop robust O&M plans.

First, there is condition monitoring technology, which enables owners to analyze the physical condition of turbines and predict when they will fail. This helps them to be more proactive about O&M and carry out work when it makes most financial sense.

Second, there is workflow management technology, which helps companies to work out how they can most effectively carry out the work that needs to be done.

This is what Shoreline offers, and can play an important role in helping companies to plan their workflows, manage their resources, predict weather windows, and track which permits they need. This enables owners to efficiently act on their O&M plans.

Third, there is enterprise resource planning software, which gives companies access to the financial and accounting systems they need to ensure the smooth running of their project work. This plays a crucial role in the business side of O&M work.

Endrerud said the benefit of a workflow management tool such as Shoreline's is that it pulls in data from a wide range of sources and

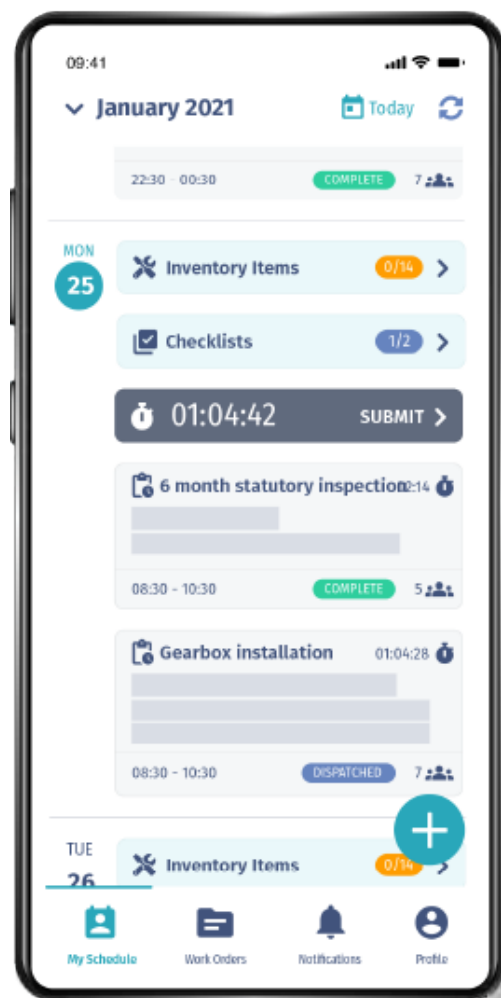
uses artificial intelligence that helps owners make better decisions.

“We have all this data gathered in one place, and we supercharge that by plugging in our AI, which can then answer: Where should they go? What should they do and with whom should they do it to maximize production? By minimizing the time for repair and minimizing the losses, we can forecast how the project is going to perform for the next nine months if we go ahead with this strategy,” he said.

This can benefit individual projects, and also help to refine approaches to O&M that will progress the industry as a whole.

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**Ole-Erik Endrerud,**  
CEO and founder  
at Shoreline Wind





# Conclusion

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Offshore wind owners must take O&M seriously and evolve their processes if they are to succeed in the highly competitive offshore wind sector.

Some of the difficulties with developing robust long-term O&M plans are based on adversarial relationships that can exist in some parts of the sector, but companies throughout the value chain are racing to deliver huge growth in capacity while faced with slimmer profit margins. But that should help to provide the impetus for change.

There are three points to take from this white paper:

## 1. O&M plans must take into account technology change

The global expansion of offshore wind has been underpinned by larger turbines that have helped to drive down costs. Owners need O&M plans that enable them to look after these turbines effectively, as well as the other BOP infrastructure, and ensure their projects are profitable. New technology often brings new issues to manage.

## 2. Companies must collaborate on O&M through the life cycle

Owners face inter-company challenges to develop robust O&M plans, including the difficulties of owners and OEMs working on parallel O&M strategies on single sites; and the need for owners to align with contractors in the construction, commissioning and handover process. The right digital systems can help make this smoother.

## 3. In-depth digital systems help you make smart O&M decisions

Digital technology exists that helps offshore wind owners understand how technology at their project is performing, as well as the effectiveness of any work carried out on it. This gives them the information they need to make the right short-term decisions on O&M, and also the longer-term picture on how long they can profitably run an asset.

Better information leads to better O&M planning – and there are solutions available that help empower owners with the information they need.





Would you like to talk about the risks explored in this report? Or find out more about how our industry standard digital optimisation tools for wind farm planning, CMMS and resource management can help with your projects?

If so, please contact the team  
[www.shoreline.no/contact-us](http://www.shoreline.no/contact-us)

The background of the entire page is a photograph of a wind farm at dusk or dawn. The sky is a deep blue, and the sea is dark. Several wind turbines are visible, with one in the foreground being much larger and more prominent than the others in the distance. The Shoreline logo, consisting of a stylized 'S' icon followed by the word 'SHORELINE' in a bold, sans-serif font, is centered in the upper half of the image.

**SHORELINE**

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