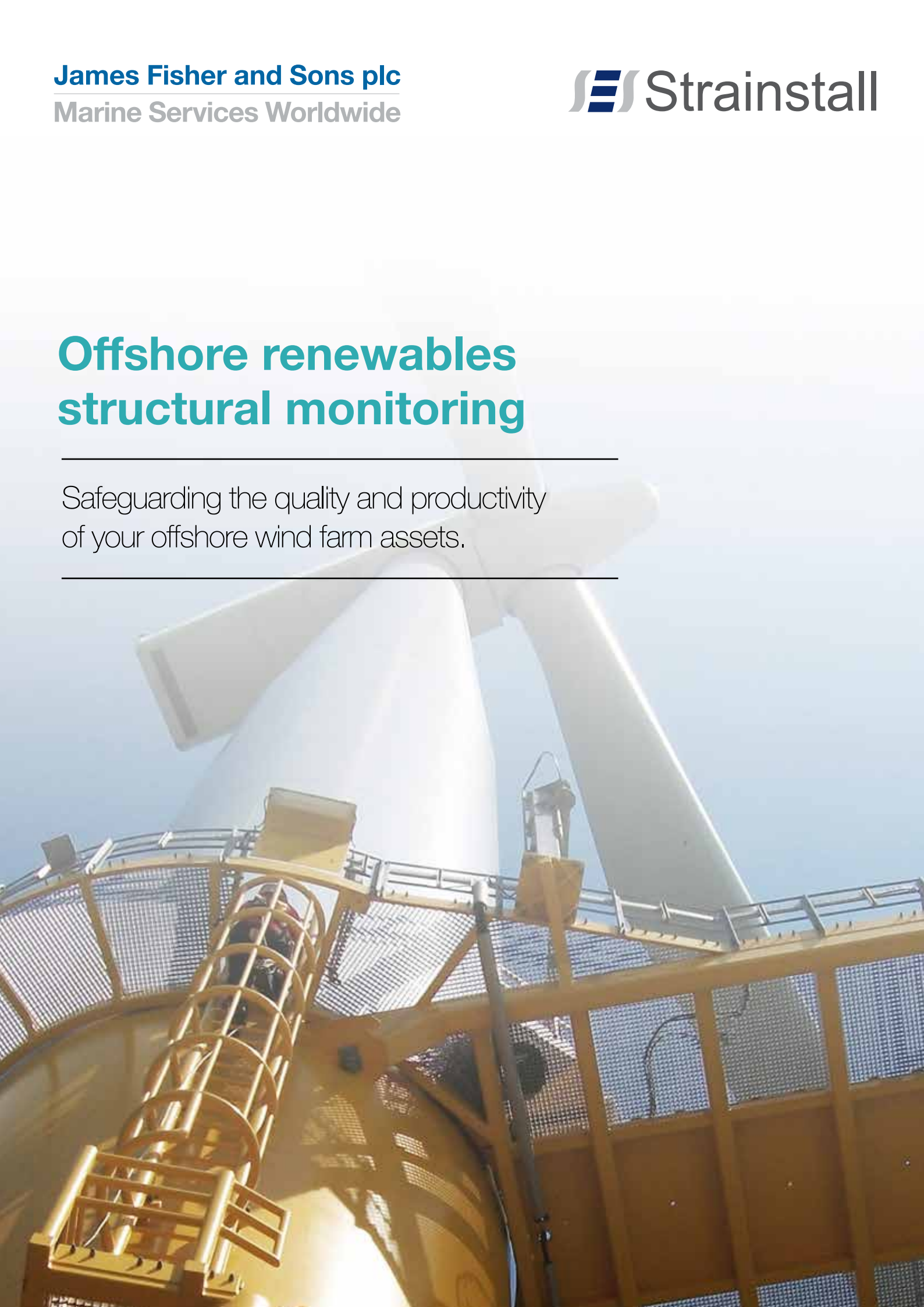


Offshore renewables structural monitoring

Safeguarding the quality and productivity
of your offshore wind farm assets.



Specialist offshore expertise

Strainstall has unrivalled experience and expertise in the provision of structural health monitoring solutions for a wide range of offshore structures ensuring safe asset operation, minimal risk and cost-effective maintenance programmes.

Strainstall provides a full specialist support function that goes far beyond the remit of most other monitoring company capabilities.

A part of James Fisher and Sons plc group of companies, Strainstall has access to a wide range of support services including confined space support teams, diving teams, rope access teams and vessel support through which its customers can benefit. Combining the group's in-house marine experience, innovation and established commercial best practice, Strainstall brings together a streamlined service delivery solution to ensure improved cost-effectiveness and efficiencies for our customers' onshore and offshore projects all under a single contract.

Experts in supporting new build projects for both onshore and offshore works, we also conduct retrofit installations offshore. Meeting the evolving needs of the renewables industry remains one of our priorities and drives us to undertake challenging projects which we deliver using our industry capabilities and exceptional professional standards.

Reasons for offshore structural monitoring

1. Design validation

Obtaining structural response data under a variety of weather and sea state conditions to verify design model assumptions.

2. Short-term monitoring / problem quantification

Assessing the extent of structural health issues on existing structures and monitoring any remedial solutions.

3. Long-term asset management

Continuous monitoring to help plan preventative maintenance strategies and to enable asset owners to make informed decisions.

4. Independent project certification

Ensuring regional project certification requirements to safeguard the quality and productivity of wind farm projects.



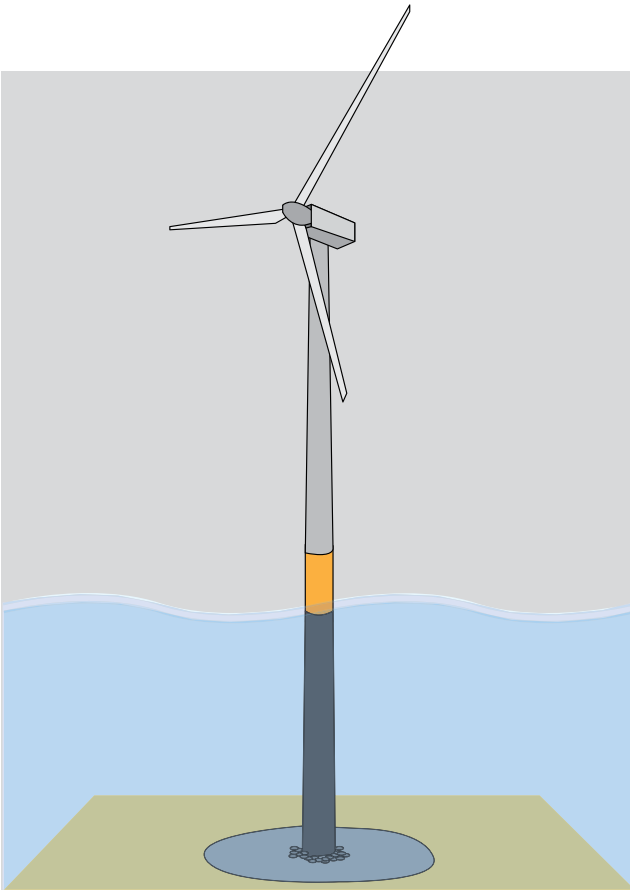
Projects delivered



59 assets instrumented to date with more in the pipeline
Eight operator clients at 12 wind farms

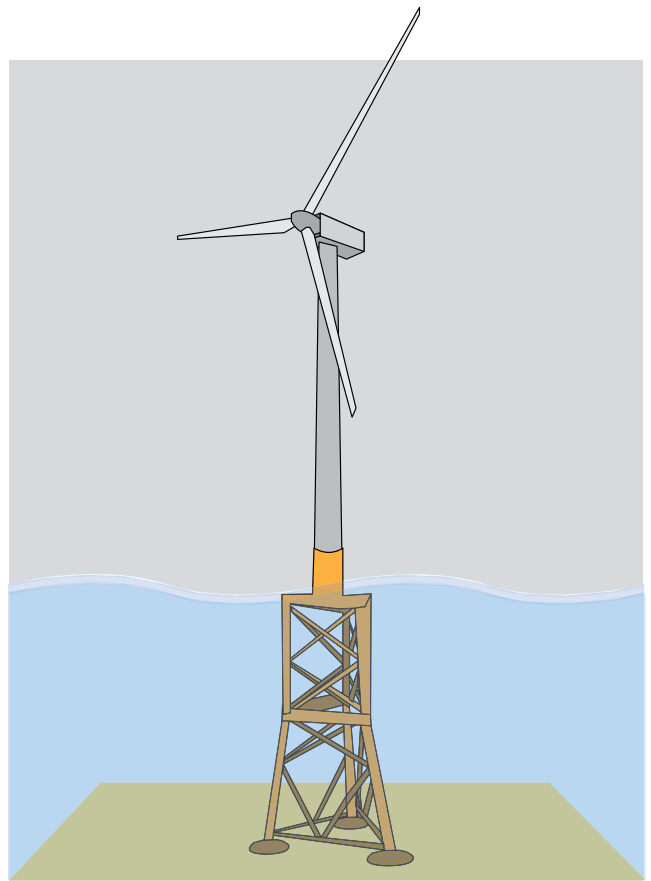
Offshore monitoring solutions

Monopile foundations



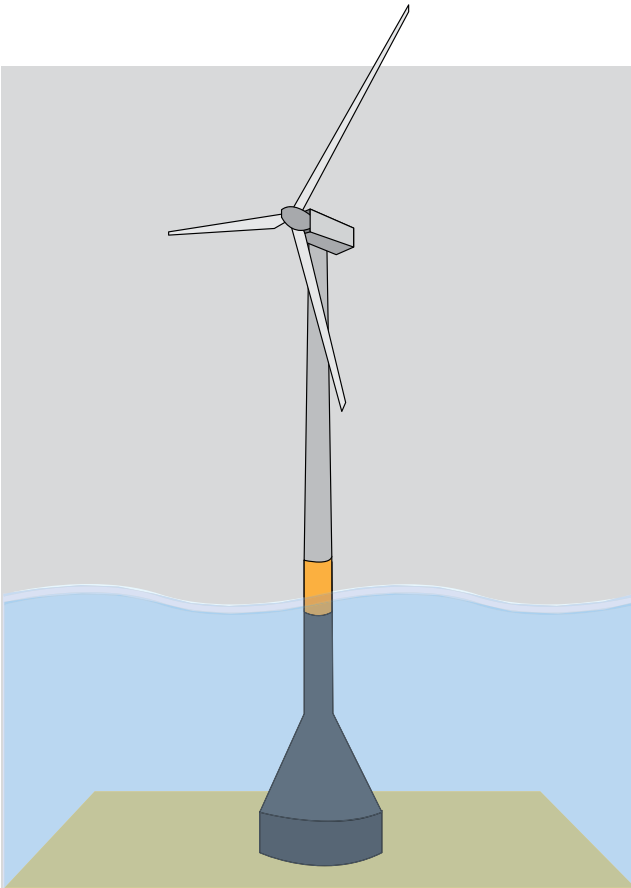
- Strain gauges for monitoring global bending and stress hotspots in monopiles (MP), transition pieces (TP) and towers
- Accelerometers and inclinometers mounted in the TP, towers and on J-tubes
- Displacement sensors at the MP/TP grouted joint
- Strainstall load cells at the MP/TP bolted joint
- Air/gas sensors for monitoring hydrogen, oxygen, hydrogen sulphide, temperature and humidity
- Water column sensors for monitoring PH, pressure, dissolved oxygen, corrosion rate and dissolved sulphide
- Wave radar on external platform
- Scour sensors looking at seabed

Jacket foundations



- Strain gauges for monitoring global bending and stress hotspots in legs, braces, buckets, pile stoppers and towers
- Accelerometers and inclinometers mounted in the transition pieces (TP) and towers
- Wave radar on external platform
- Scour sensors looking at seabed

Gravity base foundations



- Strain gauges for monitoring global bending in steel vertical section
- Concrete embedment sensors fitted within rebar cages (onshore) prior to concrete pouring and setting - alternative fibre optic version available
- Accelerometers and inclinometers mounted in foundations and towers
- Strainstall load cells installed at bolted flange during turbine installation works
- Wave/current profiler and scour sensor on base
- Environmental sensors

Floating foundations



- Strain gauges for monitoring global bending and stress hotspots in structures and towers
- Accelerometers mounted in structures and towers
- Strainstall load shackles attached to tendons

Bespoke monitoring solutions

Designed to operate within the harshest of environments, our sensors and monitoring systems ensure safe operation when it matters, on some of the most high profile structures in the world.

Monitor | Identify | Act

Our specially developed data management systems can be integrated with third party sensors for real-time data handling with online analytical processing tools. Users can run queries, perform analysis and produce reports to support operator decision-making and enable fully informed and safe maintenance assessments.

Structural health monitoring hardware

Our systems are designed to incorporate a modular network of data acquisition units (DAUs), sub-units and third party systems. Each DAU receives multiple inputs from a variety of sophisticated sensors distributed throughout the turbine foundation structure.

The data processing and control system consists of a number of hardware servers which collect, control and store data received from the DAUs. The web application server displays the structural performance of the turbine and real-time monitoring of key predefined parameters, whilst the post-processing application server will perform post-processing and analysis of the collected data.

Structural health monitoring software

Incorporating Strainstall's Smart Asset Management (SAM)[™] system, the customisable TurbineWatch[™] user interface operates and manages all data generated using modular and scaleable open framework architecture.

The software capabilities of the TurbineWatch[™] system include real-time processed information, systematic storage and retrieval of data and manipulation of multi-platform analysis. Fully flexible, the system enables a wide mix of sensors to communicate with the server in order to integrate data from any source and respond to the server configuration, for a completely dynamic two way communication.



Data management options:

1. Fully integrated into the life management of your structure, our highly sophisticated Smart Asset Management (SAM)[™] software provides the ultimate solution for convenient and reliable long-term structural health monitoring
2. Short-term design validation campaigns and live data streaming for management and analysis by our in-house experts or by the client directly for their own data processing
3. Standalone units for manual data retrieval



Strainstall

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