Measuring environmental and structural loading on offshore structures can generate cost savings by extending operating life, identifying design conservatism and providing long-term integrity assurance and design verification.

**INCREASE SAFETY AND REDUCE COSTS**

Offshore structures are exposed to complex environmental conditions, which can lead to structural failures. Anticipating failures before they happen is important to help increase safety and lower any possible risk to the environment.

Finding failures between inspections allows structures to be made safer quicker therefore avoiding more expensive repairs in the future.

**FUGRO SOLUTION**

Fugro provides a range of monitoring services for subsea and topside structures that help anticipate or detect structural issues.

- Wellhead and Riser Instrumentation Service (WARIS)
- Fixed jacket online monitoring
- FPSO mooring monitoring
- Jackup relative motion monitoring
- Response measurements

Fugro delivers many bespoke monitoring solutions for a range of applications tailored to the clients specific requirements.
WELLHEAD AND RISER INSTRUMENTATION SERVICE
The combination of deepwater operations, working in areas of high ocean current and the use of heavier BOPs result in wellheads and risers experiencing greater fatigue.

Due to the environmental and financial consequences of a fatigue induced wellhead failure, conservative assumptions have to be made during the preliminary analysis of wellhead integrity. These conservative assumptions can shorten drilling campaigns and reduce the actual operating window of drilling vessels.

The Wellhead and Riser Instrumentation Service (WARIS) accurately determines and tracks fatigue on wellheads, drilling risers and production risers against predictions. WARIS can also identify vortex induced vibration (VIV) events, estimate soil stiffness changes during a campaign and provide data for verification of riser models to help improve the efficiency and safety of well operations.

The core WARIS setup consists of DeepData subsea motion sensor pods deployed as stand-alone, self-logging devices. The Deepdata pod is specifically designed to meet the needs of the oil and gas industry and comprise accelerometers and angular rate sensors in a 4 or 6 degree of freedom configuration.

This core setup can be extended with hydroacoustic communications for real-time updates to the surface. Current profilers and wave radar can be added to correlate metocean conditions with subsea structural motions.

Benefits
- Enhances the understanding of wellhead integrity and riser behaviour
- Reduces environmental and financial risk
- Reduces drilling downtime

ON LINE MONITORING (OLM)
Many jacket structures around the world are now reaching or have exceeded their original design life and this presents new challenges for structural integrity management.

The use of OLM can complement ongoing inspections as part of an overall Structural Integrity Management (SIM) plan. This is consistent with recommended practices API RP2A, API RP2SIM, HSE RR684 and HSE RR685, helping to reduce long term costs and increase asset reliability.

The sensors deployed on a platform consist of accelerometers at various locations and optional wave-radar or anemometer to help correlate structural motions with weather conditions. Significant change to the monitored natural frequencies from their long-term averages could indicate a loss in stiffness due to brace failure and require further investigation.

Benefits
- Allows immediate detection of brace failures
- Improves personnel and environmental safety
- Improves structural reliability
- Long term cost reduction
FPSO MOORING MONITORING
An FPSO mooring line failure may have serious consequences including structural damage and failure of risers.

Using angle sensors fixed to the mooring lines above the sea level, Fugro’s Anchor Line Angle Monitoring System (ALAMS) detects mooring line failure by monitoring the mooring line angle in real-time. Sudden changes in angle will occur in the event of a mooring failure.

Benefits
- Can be retrofitted
- Provides real-time notification of chain failure
- Not subject to the reliability issues of strain gauge based systems
- Augments the Fugro Position Monitoring System
- Easily maintained

RELATIVE MOTION MONITORING
Cantilevered drilling configurations can have a high degree of relative motion between the jackup platform and the wellhead structure.

A movement alarm system is used to continuously monitor the movement of the two structures providing clear information for disconnect and re-connect decisions to be made with confidence. Downtime is therefore minimised without compromising safety.

The alarm thresholds for a specific project can be developed after discussion with the operator. Typically, an alarm is indicated if the extreme motion envelopes of each structure overlap during a given period.

Benefits
- Increases operating window
- Improves safety
RESPONSE MEASUREMENTS

Platforms undergo major structural changes during their lifetime due to damage during a hurricane, collision or addition of new modules to the existing structure.

The response measurement system provides information on the dynamic behaviour of the platform which is used to assess if there has been any change in structural stiffness.

This is achieved by measuring the movements of the structure and processing the data collected. The response characteristics of the platform can then be used to refine the engineering model of the platform.

Platform motion data can be complemented by using a wave radar to measure wave height at the same time as the response data is collected.

Wave loading is the dominant excitation, recording waves and platform motions gives a complete picture of the structural response of the platform.

Benefits
- Damaged platform assessment
- Monitoring during platform modification
- Monitoring during structural repair work
- New platform design verification