Data-Centric Solutions: Preparing Vessels for the Future of Oil & Gas

Author: A. Fernandez

Senior Electrical Engineer

DNV - Noble Denton Consultants

MTS Dynamic Positioning Conference — October 11–13, 2025

Abstract

As the global demand for connectivity and electrification surges, driven by proliferation of data centres and interconnected infrastructure, the requirements for subsea interconnection systems are expanding rapidly. This trend is accompanied by greater integration of power and fibre optics within O&G subsea electrical architectures, envisioning streamlined fibre and electrical power umbilicals to power and control subsea Xtrees.

This paper examines the readiness of subsea vessels supporting fibre optic installation to meet emerging risk management requirements. It identifies key gaps and their potential impact on operations within the O&G sector, including deficiencies in dynamic positioning record-keeping, the need for regular annual trials, and an over-reliance on class-based assessments.

The paper also explores solutions, emphasising data-centric approaches and applications for testing vessel performance. As these concepts are new to vessel crew, clear guidance is essential. Solutions include anticipating increased demand, upgrading vessels, adopting data-driven testing protocols, and enforcing rigorous, modernised operational standards to ensure safe, resilient, and future-ready subsea infrastructure.

Abbreviations

DP	Dynamic positioning
IMCA	Internation Marina contractors association
JDP	Joint Development Project
MTS	Marine Technology Society
O&G	Oil and Gas
OCIMF	Oil Companies International Marine Forum
SFT	Single-fault tolerance
WCFDI	Worst Case Failure Design intent

Introduction

Why Data-Centric? Installation and maintenance windows are increasingly tight, while charterers now expect dynamic positioning assurance that goes beyond simple “Class” compliance. They demand evidence-based predictability aligned with MTS DP Operations Guidance and IMCA M190. These frameworks enable better risk management and provide a clearer understanding of the operational constraints of vessels on hire. [1][2]

A pivotal development in 2025 is the unified approach from IMCA, MTS, and OCIMF. This initiative refocuses the industry on proving Single-Fault Tolerance (SFT) in absolute terms, supported by transparent, documented evidence across design, testing, and operations. [3]

Concurrently, the cable-lay and repair fleet is small and ageing, with high utilisation in Asia driving frequent backlogs. With global cable kilometres projected to rise ~48% and annual repairs ~36% by 2040, predictable vessel readiness and accelerated acceptance cycles become decisive for energy projects that rely on these assets.[4][5]

The cable-lay and repair fleet faces unique challenges. It is both small and ageing, with roughly 62 vessels worldwide, many over 20 years old. These ships are started to be tasked with energy-sector projects outside their traditional operating sectors in the telecoms. Historically, such vessels relied on class approvals to satisfy charterer requirements, but this approach is shifting as it may no longer meet their clients' expectations. [6]

As it stands, the rapid growth of data centres and electrified offshore assets, combined with global demand for interconnectivity, has made subsea fibre the nervous system of both the energy sector and the digital economy. Supporting a "ready-for-action" approach, with the aid of data-centric evidence, requires both charterers and operators to align in requirements at the earliest of discussions to ensure timely executed projects and effective risk management.

Requirements landscape: from class-based to evidence-based

Traditionally, compliance with DP requirements had been demonstrated through third party witness and class surveys. These surveys are human-led inspections designed to reduce risk and confirm that a vessel meets prescribed standards for DP capabilities[7]. While effective for verifying design compliance and general condition, this is inherently a snapshot-based approach and relies heavily on observation rather than continuous performance data. This approach satisfies statutory and class rules but does not fully address the desired to fully capture potential operational risks associated with complex, high-reliability DP operations.

The recent unified guidance from IMCA–MTS–OCIMF marks a fundamental departure from traditional compliance, prioritising performance validation over procedural conformity. Modern guidance reflects a shift toward evidence-based assurance and these frameworks collectively signal that assurance is no longer just about passing a survey, it is about demonstrating a system's integrity under real operational conditions.[3]

A data-centric approach delivers benefits that some class-based compliance methods cannot. The aim is to compile and manage evidence that can be better understood and be used to validate DP performance, detect latent failures, and provide charterers with objective proof of system integrity. Such approach supports risk-based decision-making and reduces ambiguity during assurance. In short, while class surveys remain essential for confirming baseline compliance, the industry's trajectory clearly favours data-driven assurance as the progress to a safer, more resilient, and future-ready operations.

Common readiness gaps on fibre-capable vessels

At the heart of this challenge is the assumption that cable-lay and repair vessels were designed primarily with a focus on fibre-optic technology, with DP systems supporting functionality to enable successful operations. It is also implied that their natural market, telecommunications, has historically not required rigorous DP performance validation or data-centric evidence, as most campaigns have different objectives and approaches to risk management. As a result, these vessels now require an uplift to align with baseline practices common in the energy sector for DP operations. Several gaps illustrate this need:

- Record-keeping is often fragmented, with incomplete or missing operational logs.

- Periodic and annual trials are frequently diluted, aligned with class survey schedules to minimise dedicated testing time.
- Aging systems and limited functionality restrict what can be captured as evidence for later analysis.
- Class compliance is often viewed as the sole requirement to demonstrate vessel operability.

These practices fall well short of the structured, evidence-based assurance now demanded by charterers in energy projects. Closing this gap will require more than investment in technology [5][6] it calls for an ecosystem approach, cultural change, and cross-disciplinary collaboration. These steps will enable assurance frameworks that elevate vessels from compliance-oriented operations to data-driven, performance-validated readiness.

Benefits and burdens of data-centricity

Adopting a data-centric approach delivers significant advantages for DP assurance (Benefits).

- First, it provides higher assurance and faster approvals by replacing subjective statements with clear, auditable data packages that allow charterers and third-party reviewers to verify performance independently. This transparency reduces ambiguity and streamlines the risk management process.
- Second, data-centric evidence enables better traceability, using digital or cumulative constructs and planned maintenance records to satisfy verification requirements without extending vessel downtime, an important benefit for vessels operating under tight installation windows and a reduced fleet.
- Third, when a system is ready for data acquisition it supports better incident learning through evidence-rich replays that capture synchronised system behaviour during faults or anomalies. These replays provide granular insight for root-cause analysis and continuous improvement, helping operators prevent recurrence and strengthen operational resilience.

However, realising these benefits requires deliberate change (Burdens).

- First, there is a crew workload component: capturing, curating and securing higher-fidelity evidence adds tasks to already lean teams unless a robust process where roles, equipment, checklists and templates are in place.
- Second, vessels must invest in tooling and training, establishing a common time base across, using capture tools, and implementing secure retention so evidence remains verifiable and tamper-resistant.
- Third, there is a change in mindset for fleets coming from telecommunications-driven norms into O&G style assurance: trials must be re-scoped around improved traceability and periodicity, watchkeepers need simple “what to capture” guides; and stakeholders need alignment on why data-centric outcomes matter.

Managed well, these burdens are finite and front-loaded; once the practices and templates are embedded, day-to-day friction drops while assurance quality rises.

Anonymised case

During recent proving trials on a fibre-optic installation vessel following a significant DP upgrade. i.e. 20+-year-old system was enhanced with sensors, controllers, consoles, and other hardware, the surveyor was asked to assist in meeting an upcoming charterer's request for data-centric evidence. This evidence was required for specific tests not fully covered by the stipulated testing regime.

The surveyor explained that this type of testing had initially been proposed to prepare for clients with such requirements; however, it was previously declined due to time and budget constraints. After the scope and support requirements were understood, the vessel's crew and the surveyor collaborated to define a plan and identify the information to be collected, including time-stamped alarm lists, data trends, and screenshots of DP plots and automation mimics. This process produced a robust, triangulated dataset that demonstrated both the system's performance and its limitations.

This thorough exercise helped identify and rectify several design deficiencies, including single points of failure that exposed the vessel to failure modes exceeding the WCFDI.

Although the operator had "passed" class survey and attempted to demonstrate compliance through that, having all evidence recorded during the trials proved immensely beneficial. Results that did not meet expectations were easier to visualise and discuss with the engineering team. The charterer's requirement for data-centric evidence ultimately drove design improvements, but only after supporting the operator in identifying accurate and relevant information to extract from its systems. Once the limitations and performance challenges were understood, the charterer proceeded with its own risk-management measures, and the project moved forward with appropriate control mitigations.

Conclusions

The shift from class based compliance to evidence based assurance is no longer optional for vessels entering projects where operational integrity is critical. For fleets historically shaped by other sectors e.g. telecommunications, this represents both a challenge and an opportunity: a challenge because legacy practices cannot satisfy modern risk expectations and an opportunity because adopting data-centric methods delivers faster approvals, stronger risk management, and actionable insights that improve design and operations.

Closing the readiness gap will require more than technology upgrades. It demands cultural change, structured processes, and cross disciplinary collaboration between operators, charterers, and assurance bodies. The case study demonstrates that when data-centric practices are applied, even on ageing assets, they expose hidden vulnerabilities, enable informed decision making, and ultimately protect project outcomes. In a world where subsea fibre and power form the future of the energy sector, the ability to demonstrate DP integrity with verifiable evidence is not just good practice, it is a strategic necessity.

References

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