Offshore Network

Asset Integrity Management Australia Report

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INTRODUCTION

The age profile of offshore facilities in Australia is similar to that of facilities in the North Sea, ranging from just a few years to more than 50 years old. Many platforms, pipelines and other marine infrastructure were built in the 1970s-1990s period and, as such, numerous assets are approaching or even exceeding their original design life.

Ageing infrastructure can increase the likelihood of corrosion, fatigue cracking, structural degradation and pipeline deterioration, among other concerns. But ageing is not just how old equipment is; it is about its condition, and how that is changing over time, a point highlighted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) in a 2026 report on ageing assets and life extension.

"Ageing is the effect whereby a component suffers some form of material deterioration and damage (usually, but not necessarily, associated with time in service) with an increasing likelihood of failure over the lifetime," the report notes, also citing the UK's Health & Safety Executive.

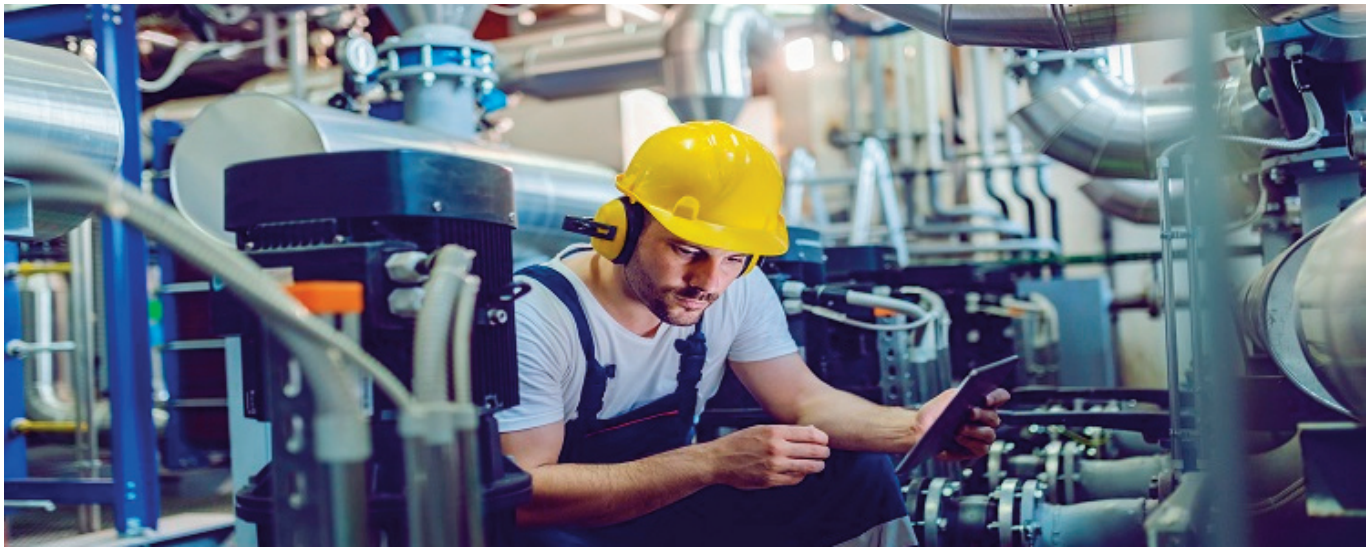
With many operators opting to extend asset life instead of replacing facilities, asset integrity management (AIM) is now a primary challenge for the industry. Decisions and actions must carefully balance cost, safety, regulations and the condition of ageing infrastructure, all the while keeping projects viable.

But Australia is not alone. NOPSEMA's inspection activities across Australia over the past decade have confirmed that many of the issues identified in the North Sea are much the same, providing important learning and opportunities for knowledge sharing in the face of such a complex task.

PRODUCTION DEMANDS & INTEGRITY CHALLENGES

AIM is a challenge that industry operators must navigate among a myriad of other priorities, and is fundamental to reducing operational downtime. Offshore production remains integral to economic well-being, which means sustaining output, including continued LNG exports and maintaining oil and gas flows from mature fields, are of national and strategic interest.

Integrity challenges must be built into a robust and resilient operational strategy, with a focus on areas such as corrosion (internal and external), fatigue caused by waves and cyclic loading, and the harsh marine environment and inspection difficulties underwater. While technology is today a major ally in this work, this brings with it a burden of new challenges, including cybersecurity risks associated with digital monitoring systems.



Source: Adobe Stock

Increasing regulatory expectations, as well as safety and environmental protection issues, further add to the workload of operators tasked with the steady reliability and performance of ageing assets.

So how should operators respond to this unique and increasingly complex set of challenges? At its core, AIM focuses on three central pillars: prevention, detection and repair.

Prevention means implementing risk-based maintenance, routine inspections and engineering controls to minimise asset degradation and reduce the likelihood of failure.

Detection involves applying condition monitoring, non-destructive examination (NDE), and predictive techniques to identify defects and degradation before functional failure occurs.

Repair requires undertaking timely corrective maintenance, repair, or component replacement to restore asset integrity and maintain safe, reliable operation.

An effective strategy is likely to incorporate a whole host of measures and technologies, from predictive maintenance using sensors and condition monitoring through to regular structural inspections using ROVs and drones. Underpinning this will be a strong safety culture and competency training to ensure compliance with Australian regulations and international standards, and underline the message that integrity management should be preventive rather than reactive.

EFFECTS OF AGE ON INFRASTRUCTURE

When it comes to extending the life of existing assets and developing a robust AIM plan, issues such as corrosion, mechanical degradation, flow assurance challenges and other age-related threats all come into sharp focus.

As offshore fields mature, changes in hydrocarbon composition, production conditions and inventory can also alter the likelihood or consequences of potential accident events. Increased gas, water cut or hydrogen sulphide content, for example, may reduce the effectiveness of safety systems originally designed for different operating conditions. As a result, periodic reviews of safety cases and permissioning documents are required to confirm that technical controls remain appropriate for the evolving risk profile.

Ageing also affects the performance of critical technical controls by reducing their functionality, availability, reliability, survivability and interdependence. Equipment deterioration may occur progressively through wear and corrosion, or manifest as sudden failures.

Older assets often experience increased maintenance demands too, while difficulties sourcing obsolete spare parts and reduced workforce familiarity with legacy systems, can all prolong repair times or increase the likelihood of equipment remaining in a failed state. Furthermore, ageing can reduce the ability of systems to withstand fire, explosion or other extreme events, while dependencies on common support systems, such as electrical power or cooling water, may increase the potential for cascading failures.

ORGANISATIONAL & CULTURAL CHALLENGES

According to NOPSEMA, operators are expected to understand the degradation mechanisms affecting their facilities and to implement strategies that ensure safe operation throughout the asset lifecycle, including any life extension activities.

Effective management requires a clear understanding of the asset's anticipated end-state, together with the resources and time necessary to achieve it. In addition to physical degradation, however, organisational ageing can present a further AIM challenge. The loss of experienced personnel, changes in operators, contractors and information management systems can result in the erosion of critical knowledge required to identify degradation mechanisms, maintain safety-critical equipment and preserve the integrity of ageing offshore assets.

Managing both technical and organisational ageing is therefore essential for maintaining effectiveness and ensuring continued compliance with Australia's offshore regulatory framework.

While any strategy should be preventive rather than reactive, once ageing damage becomes significant, rapid or widespread, existing approaches to managing critical technical controls may not be sufficient, and a more proactive, integrated approach may be required.

Often the new approach requires those responsible to evaluate the actual condition of the asset and establish what resources, including skills and knowledge, are needed to rectify the problem. A framework of management processes can help organisations assess whether their response is appropriate to match the scale and dynamics of the ageing threat.

MANAGING AGEING ASSET RISKS

Current practices in quality and safety management typically use the plan-do-check-act model as an iterative process for driving continuous improvement, according to NOPSEMA.

The Energy Institute published a research paper describing a framework for managing ageing assets that also follows the plan-do-check-act approach. This offers a starting point for embedding a robust culture into AIM planning.

The main activities in this process are the development of a corporate strategy or policy for the management of ageing assets and infrastructure, and the management and monitoring of the effectiveness of critical technical controls for ageing effects, along with the implementation of remediation schemes and the effective auditing of management processes.

THE REGULATORY LANDSCAPE

As ageing assets account for a significant share of Australia's offshore production, the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) has tightened its regulatory guidelines, requiring operators to demonstrate that their ageing infrastructure will continue to operate safely throughout its lifecycle.

According to NOPSEMA's '**Ageing Assets and Life Extension'** guidance, operators must perform their due diligence to ensure facilities remain operational beyond the asset's 'original lifespan'. One key principle of regulatory compliance is that 'ageing' is determined not by age alone but by the deterioration of an asset's condition. NOPSEMA expects operators to adopt a condition-based approach to asset integrity management, supported by evidence that deterioration has been identified, monitored, and controlled.

Several high-profile case studies have reinforced the importance of asset management, none more so than the Northern Endeavour FPSO facility. After the operator declared bankruptcy in 2019, the FPSO came into the Australian Government's hands. Assessments of the FPSO identified numerous integrity concerns that required remediation before the decommissioning process could begin, including deferred maintenance and deteriorating equipment. This case is often used to illustrate how integral consistent integrity management, effective regulatory guidance, and long-term planning are for ageing assets within Australian waters, and across the globe.

NOPSEMA's guidance reinforces that ageing asset management should be included within an operator's existing safety management systems, rather than treated as a standalone activity initiated near the end of an asset's life. Under the Offshore Petroleum and Greenhouse Gas Storage (OPGGS) legislative framework, operators are expected to maintain consistent levels of inspection, maintenance, monitoring and verification throughout an asset's operational life. Managing the ageing and deterioration process forms an integral part of regulatory compliance.

Emphasis is placed on the management of **safety-critical elements (SCEs)**, recognising that deterioration of these systems may have consequences for both personnel safety and environmental protection. Operators are expected to understand the degradation processes affecting SCEs, establish measurable performance standards, and implement inspection and maintenance programmes to help identify deterioration before failure occurs.

Demonstrating that SCEs continue to meet their required performance standards is especially important when facilities are operating beyond their

original lifecycles.

Extending the life of an asset attracts additional regulatory scrutiny, according to NOPSEMA, as the extension introduces greater uncertainty about future performance. The decision to extend the well lifecycle must be carefully considered by operators, with several factors to consider, including structural integrity, equipment reliability, corrosion, material degradation, changes in operational conditions, and the effectiveness of existing inspection programmes. Operators must be able to demonstrate that risks remain as low as reasonably practicable (ALARP) throughout the proposed extension period, and that the facility continues to meet safety expectations.

NOPSEMA's guidelines also encourage operators to move beyond reactive maintenance decisions and instead work towards a more predictive, risk-based integrity management process. All data, from Inspection results to equipment failures, should be analysed collectively to identify emerging degradation trends before they compromise safety or performance. NOPSEMA notes that many organisations already collect substantial operational data, but do not always fully utilise it.

NOPSEMA's guidance positions ageing asset management as a continuous obligation. The lessons learnt from the Northern Endeavour and other global examples demonstrate the consequences of allowing maintenance backlogs and equipment deterioration to build up over time. Effective ageing asset management integrates engineering assessments, risk management and lifecycle planning to ensure facilities remain safe and reliable throughout their operational life.

HEALTH, SAFETY AND PROCESS SAFETY EXCELLENCE

A strong process safety culture, systematic risk management and effective leadership need to be integrated into asset integrity programmes to prevent major incidents, protect personnel and maintain safe and reliable operations in the high-hazard offshore oil and gas industry.

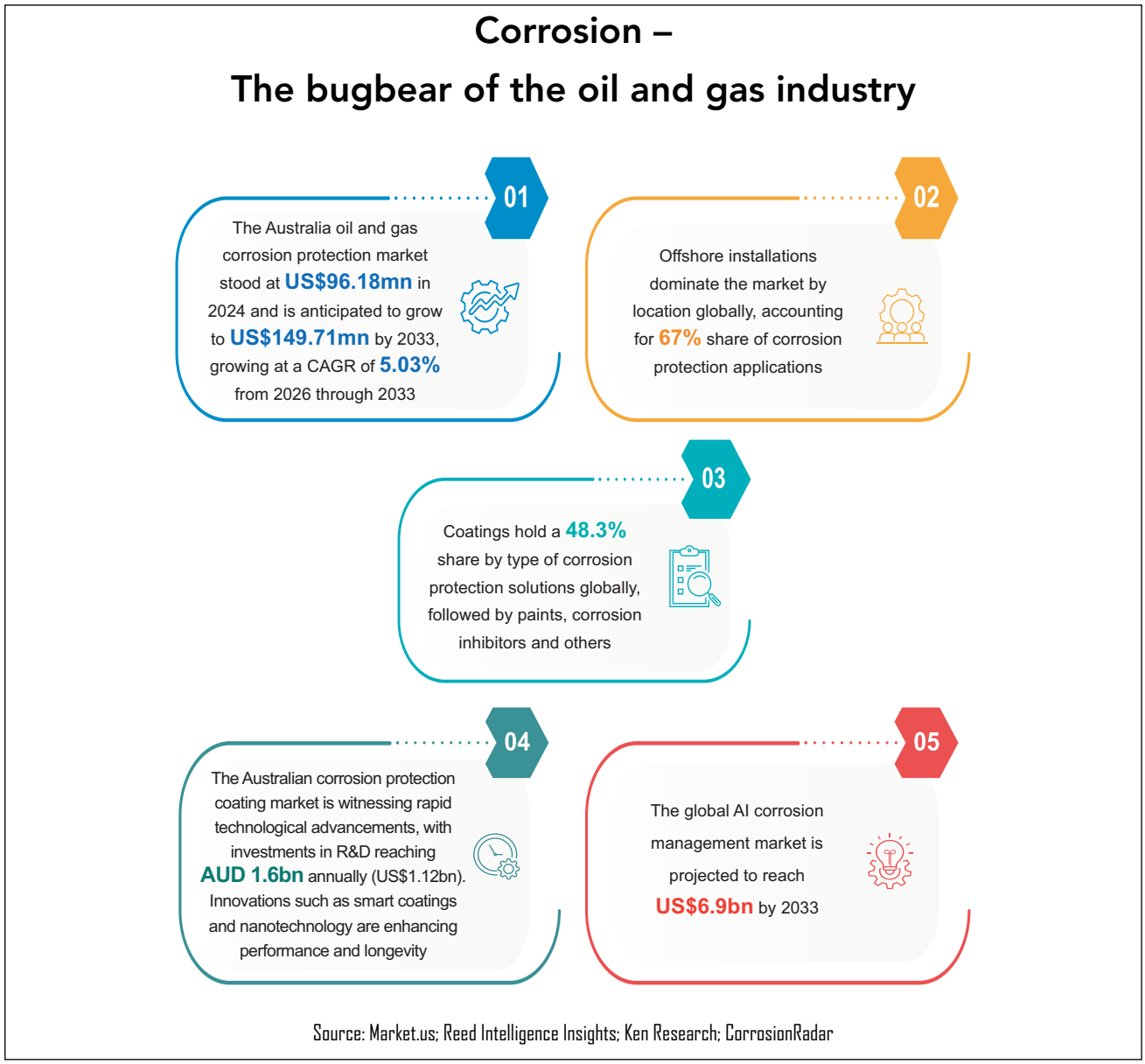
Inadequate process safety measures can lead to serious incidents such as explosions, fires and oil spills, posing a threat to personnel, assets, the environment and reputation. This was illustrated all too clearly by the Deepwater Horizon incident, which caused the largest marine oil spill in the industry's history as well as deaths and injuries, and where defective cementing of the well and inadequate safety systems were found to have been major causes. Integrating **process safety** into asset integrity programmes needs to involve the establishment of robust inspection, maintenance, testing, and monitoring systems that ensure critical equipment remains in good condition.

Many oil and gas companies follow the IOGP's Process Safety Fundamentals (PSFs), a set of basic principles for front-line workers, supervisors and managers that emphasise good practices to prevent fatalities from process safety events. It aims to enable front-line workers to raise concerns openly and transparently, helping to ensure effective process safety management, including potential engineering modifications to address the issues raised.

"NOPSEMA expects the oil and gas industry to take all practicable steps to eliminate fatalities and major accident events across all their activities. We believe that adoption of the IOGP Process Safety Fundamentals will contribute to further reductions in process safety incidents and the achievement of that goal," said Derrick O'Keeffe, head of Division, Safety and Integrity, NOPSEMA.

Risk management provides a structured framework for proactively identifying, assessing, and controlling threats to asset integrity, enabling organisations to evaluate potential failure scenarios and implement prevention measures. A risk-based approach ensures that maintenance resources are allocated according to the likelihood and consequences of equipment failure.

Effective **safety leadership** plays a critical role in embedding process safety and risk management into everyday operations. Senior management should adopt a proactive approach, demonstrate a commitment to safety by 'walking the walk', showing a presence and engaging with employees at the worksite. They should establish clear expectations, allocate sufficient resources and support to HSE



personnel, and promote accountability at every level throughout the organisation, motivating employees to take ownership in maintaining safe work practices. Leaders should empower employees to speak up and report any concerns or incidents without fear of blame, and establish a clear process for incident reporting and learning from near misses. Training, mentoring, and regular emergency response exercises allow personnel to develop the competencies to deal with complex operational risks effectively.

There are many examples of good **safety practice** among Australia's operators. Santos, for example, has implemented a three-level assurance framework to verify that critical process safety controls and operations excellence requirements are embedded to align with its safety management system (SMS). This framework is enhanced through the addition of an operational governance forum which drives performance, compliance and learnings across its operations. Effective risk management also entails multi-tiered governance processes through live dashboard reporting of critical KPIs and key process safety and asset integrity lead and lag indicators at the asset, regional business unit and Board levels. Bowtie risk assessments are conducted to prevent loss of containment and mitigate potential escalations of loss of containment. This methodology is continuously improved in response to identified incidents and near misses.

These initiatives have helped Santos reduce loss of primary containment (LOPC) rate by 27% (from 0.22 in 2024 to 0.16 in 2025) and loss of containment incident rate (LOCI) by 43% (from 0.14 in 2024 to 0.08 in 2025).

WORKFORCE CHALLENGES

Skilled workers with specialist expertise are a prerequisite for designing and implementing effective and cost-efficient asset integrity management strategies.

"Oil and gas operators increasingly require multi-skilled inspectors with cross-disciplinary capability spanning non-destructive testing and condition monitoring," comments Stuart Norman, CEO of Australia's Institute of Non-Destructive Testing in an article for Petroleum Australia. "Strong analytical skills, clear reporting and familiarity with regulatory frameworks are now baseline expectations. The ability to interpret data, assess significance and communicate risk to engineering and management stakeholders is critical. Inspection integrity is inseparable from workforce competence."

He notes that environmental approvals, methane emission management obligations, insurance requirements and corporate sustainability reporting all intersect with asset integrity programmes, and that regulatory frameworks continue to require accountable, certified professionals to assume responsibility for inspection outcomes.

However, the oil and gas industry in Australia and globally is suffering from **skills shortages** due to an ageing workforce and challenges in attracting and retaining talent, factors at play including unfavourable perceptions of the industry with the move to cleaner energies, and evolving work expectations, such as a reluctance to spend long periods offshore.

According to the annual IEA Energy Employment Survey, nearly half of the companies surveyed reported **critical hiring bottlenecks**, which have led to project delays, longer lead times, increased costs, and higher wages. Companies also reported a shortage of candidates with the required skill levels, often resorting to hiring less qualified people, hiking salaries or turning to on-the-job training. "These pressures have implications for competitiveness and carry potential risks for worker safety, project quality and timely delivery," the IEA notes.

The rate of new graduates with energy-relevant degrees and certifications is also not keeping up with demand, which is contributing to wider pipeline issues



Source: Adobe Stock

for skilled workers.

Skills shortages are particularly acute in technical roles. Global workforce solutions provider Airswift notes a structural shortage of experienced engineers and technicians and competition from other sectors, with many energy professionals considering career changes. Companies must draw on global talent pools and create flexible staffing models to secure the right expertise at the right time, it comments.

Long-term **skills and knowledge continuity** is also a concern, notes CODA, the Centre for Decommissioning Australia. "Clear documentation and knowledge transfer around the state of assets, and effective handovers between different teams are critical for long-term sustainability," it notes. Many senior engineers and technical personnel in the workforce are due for retirement shortly, including integrity engineers and inspectors who have accumulated years of experience and expertise. The ageing workforce requires strategic planning for skills retention and capability development, with young engineers taking on asset integrity management roles.

The growing adoption of AI and digital technologies is also leading to an **evolution of technical roles** in the industry, requiring reskilling and upskilling. This is certainly the case in the asset integrity management field, where digital technologies facilitate predictive maintenance, (eg predicting corrosion rates), remote and continuous monitoring etc. Balancing the retention of traditional technical capabilities with the integration of new technologies and competencies is becoming an increasingly complex challenge, notes Airswift.

With the growing decommissioning activity in Australia, expertise is also needed to handle aged structures, to understand the different hazard exposures possible in removal, cleaning and dismantling and skills around P&A for old and complex wells, CODA says.

While policy initiatives are needed at a government level to align workforce development with evolving sector needs, at the company level, organisations need to provide **training and reskilling** for current employees to address skills gaps, whether in-house or through specialised external asset integrity management courses, along with mentoring programmes to accelerate learning on the job. Targeted **recruitment campaigns** can be conducted to recruit new employees who can be trained to fill workforce gaps.

Short **certification courses** leading to specific licences or qualifications are also useful, while modular and company training can play a role in equipping workers with product knowledge needed to install, maintain, service, or repair specific equipment. Offering opportunities to work across different projects, assets, geographies and phases of the project lifecycle can also help to broaden experience.

DATA, DIGITALISATION & INNOVATION IN ASSET INTEGRITY MANAGEMENT

With the offshore industry largely prioritising brownfield over greenfield projects to advance optimisation and sustainability, digitalisation has been a primary driver of the transition journey. It has facilitated complex data and process integration, eliminating hours of menial tasks so that operators are free to make prompter decisions and can attend to areas where it really matters. When implemented effectively, complex intervention processes become simplified with quicker turnarounds at half the cost of traditional approaches.

With an ideal setup of digital asset integrity management in place, operators can remotely monitor risks at the most inaccessible parts of gigantic offshore platforms and take timely action. Offshore environments can be accessed without arranging for ropes or scaffolding when aerial drones can reach the targeted area and click high definition images with inbuilt thermal and optical cameras. These are equipped to clearly capture splash zones, flare tips and under-deck structures.

Without diving into the ocean, everything from subsea manifolds or wellheads to pipelines can be scanned to check for leaks with the help of **remotely operated or autonomous underwater vehicles.** This is made easy with machine-vision artificial intelligence (AI) driving these vehicles. Examples include Saipem's FlatFish autonomous inspection drone which can carry out

autonomous subsea inspections.

AI can also detect and track minute shifts in temperature and vibration in critical offshore turbomachinery. This helps to flag failures way ahead in time, avoiding emergency downtime situations. Non-intrusive wireless sensors, for example, can raise alarms in cases of internal sand erosion or chemical corrosion in subsea and topside pipes. When clamped to the right zones, these sensors come alive to feed consistent, real-time information on pipe wall thickness.

One of the most innovative solutions that digital asset integrity management has seen is **digital twins** or virtual 3D replicas of complex platforms deep offshore. These replicas can combine hull structural models with real-time wave, wind and mooring line tension data. They consistently update the fatigue life calculation of floating production storage and offloading (FPSO) units or tension-leg platforms. Digital twin providers, FutureOn and SteelTrace, have collaborated to bring a one-stop-shop to operators, where all siloed systems and archived documentation can be accessed in one place.

"A digital twin only delivers real value when it gives engineers immediate access to the information behind the asset. As offshore infrastructure matures, operators need trusted material information to extend asset life, support maintenance and plan for decommissioning.

"Bringing SteelTrace's verified material records directly into FieldTwin enables operations teams to quickly access the documentation they need to support maintenance, in-field repairs and decommissioning without searching across multiple systems," said Filip Valica, vice president – corporate development at FutureOn.

Once SteelTrace's Smart Manufacturing Records is integrated into FutureOn's FieldTwin, a digital twin platform for offshore energy projects, operators can easily locate relevant documentation, such as material test records, weld records, coating documentation and NDE results, allowing faster maintenance and integrity decisions while maintaining a complete audit trail.

As well as digital innovations, advances in **corrosion-resistant materials** such as thermoplastic pipes and special grades of stainless steel, along with developments in protective coatings and corrosion inhibitors, can help to preserve asset integrity. AkzoNobel for example has launched Chartek One, a mesh-free epoxy intumescent passive fire protection (PFP) coating which provides combined corrosion and jet fire protection, while Sherwin-Williams has launched the Heat-Flex Advanced Energy Barrier (AEB) insulative coating, which tackles corrosion under insulation (CUI).

ASSET INTEGRITY MANAGEMENT WORKSHOP

Learn how to optimise your AIM strategy at our Asset Integrity Management Workshop at The Duxton, Perth, Australia, 10-11 November 2026. Find out more here: *https://events.offsnet.com/AIM-AUS-2026#*

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