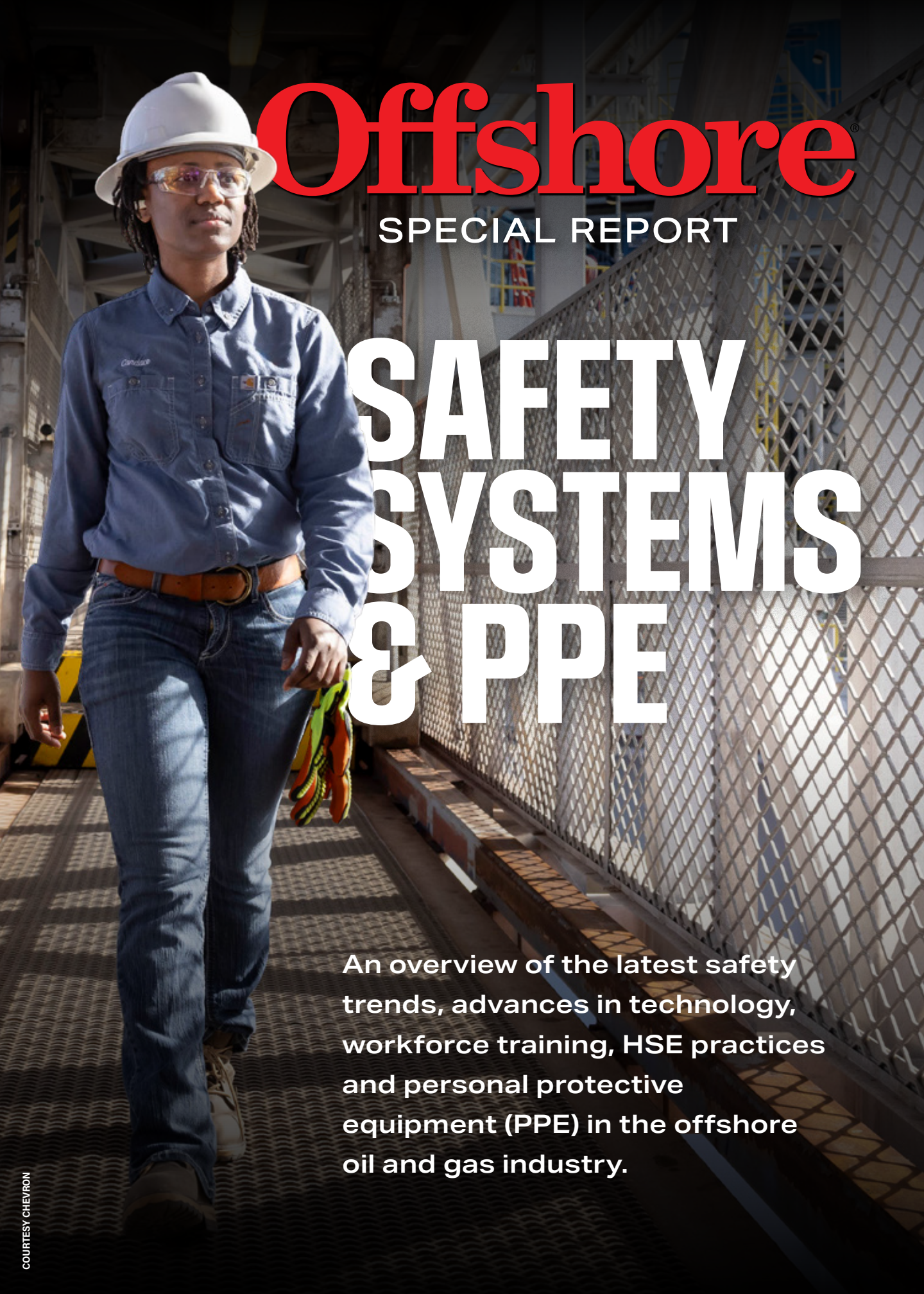

Offshore®

SPECIAL REPORT

SAFETY SYSTEMS & PPE

An overview of the latest safety trends, advances in technology, workforce training, HSE practices and personal protective equipment (PPE) in the offshore oil and gas industry.

COURTESY CHEVRON

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Safety systems and PPE advancing in the offshore oil and gas industry

A compilation of the latest HSE technologies for offshore energy workers

ARIANA HURTADO, Editor and Director of Special Reports

Offshore oil and gas operations can prove challenging with harsh environments, heavy equipment and sometimes difficult engineering, inspection and maintenance tasks at hand. It's nothing new that companies continue to seek advancements in technology, systems and processes that will increase safety for both personnel and the environment. The following is a sampling of some of the latest safety systems and personal protection equipment (PPE) that is being offered in the offshore energy sector for its workers and the overall increase of HSE efficiency.

Sensors provide rehydration strategies, real-time alarms

Epicore Biosystems develops sweat-sensing wearables. Its new Connected Hydration is a sweat-sensing wearable biosensor and cloud analytics technology that measures sweat loss, sodium loss, skin temperature and movement to provide actionable rehydration strategies in real time to workers ahead of adverse dehydration events, according to the company. The technology enables personnel to quantify their hydration biomarkers and create actionable routes to rehydration and recovery.

The Connected Hydration sweat-sensing wearable biosensor provides rehydration strategies in real time to workers ahead of potential dehydration. COURTESY EPICORE BIOSYSTEMS

The X-1000 personnel transfer device's flotation modules have been added to the upper section of the grablines and top frame to incorporate self-righting floatation without impeding rider egress. COURTESY BPC

Chevron health and safety teams have deployed Epicore's Connected Hydration across multiple work sites and conditions over the past two years, leading to its commercial launch in April 2024. Chevron Technology Ventures also invested in Epicore to support the development and commercialization of Connected Hydration.

In July, Epicore secured a three-year master services agreement with Chevron Technical Center to equip Chevron's industrial frontline workers with its Connected Hydration technology. The first deployments were scheduled to start in the US this summer.

Autonomous tools reduce personnel needs on site

SLB's Neuro autonomous technology—which was recently recognized with an OTC Asia 2024 Spotlight on New Technology Award—was designed to increase the efficiency of E&P operations and reduce human intervention and the carbon footprint. The Neuro tools entail intelligent planning and execution as well as surface and downhole automation.

"These capabilities have enabled autonomous operations across the well life cycle—improving how the industry constructs wells, proves and connects reservoirs, sustains production, maximizes recovery, and decommissions wells—laying the groundwork for fully autonomous operations in the near future," SLB states on its website.

Neuro solutions integrate technology that eliminates the need for engineers to travel to well sites. Plus, users are able to access data 24/7 from any location. "By reducing personnel on the rig site, associated travel (even travel to a workplace), HSE risks and environmental impact diminish equally," SLB added.

Personnel transfer device adds new safety features

The Billy Pugh Co. (BPC) released the X-1000 personnel transfer device in June. The company says the device incorporates new safety features following extensive customer engagement to determine what riders value in safety and comfort during transfer. The feedback the research team received was that the most preferred safety capabilities included quick egress and the ability for riders to stand during transfers and face inward, with a soft takeoff/landing.

The X-1000 features a four-person capacity, working load limit of 1,200 lb and weight of 800 lb, and it is ASME B30.23-2022 compliant and EN 14502-1 compliant. The device has a self-righting flotation system as well as a passive heave compensation for softer pickup/takeoff. In addition, individual standing cushions provide a softer landing, and there is enhanced

side impact protection on the outer perimeter as well as grabline cushions for improved rider comfort. The floor grating also offers improved viewing of landing for the rider. Moreover, X-1000 has a removable suspended seat option for emergency use and accommodates a stretcher in addition to the emergency seat.

Drones take the risk, not people

MaDfly drones focus on inspection services with the aim of preventing accidents and reducing unnecessary risks. The company's drones can reach offshore environments, confined spaces (e.g., cargo, storage, tanks) and have high access (e.g., cranes, turbine blades, etc.). Previous site inspections have included vessels, wind farms, offshore platforms, ports and storage sites.

Without the use of drones, high-area inspections would require scaffolding, rope access or cherry pickers, which can be dangerous, costly and/or time-consuming, the company explains on its website. MaDfly says the use of drones for visual inspection in high areas eliminates these risks, increasing safety and efficiency. In addition, drones can be deployed quickly and complete inspections quicker, thus reducing downtime of assets.

Late last year, MaDfly performed tanker inspections with thickness measurements conducted by drones offshore Africa. The company successfully tested its first drone-based thickness measurements in a crude oil tank on an FPSO in Angola, providing access to confined and hard-to-reach areas.

The company also provides 3D modeling, which entails a structure, property or object being recreated in a digital 3D format from pictures or LiDAR taken by a drone. The company says this virtual copy is "extremely accurate" and that an "incredibly realistic and high definition model" is produced.

MaDfly was formed in June 2019 to utilize drones to reduce the human presence in confined spaces and reduce the risks of accidents. COURTESY MADFLY

Lastly, the drones can provide aerial thermography, which is an infrared imaging process that allows the evaluation of heat emission by an object. This analysis alerts users to asset defects and/or thermal leaks.

Seal stops leaks, safeguards employees

DENIOS-US released the RuptureSeal leak stopping devices in 2023, and the company boasts they can be easily deployed in seconds to form a secure mechanical seal that stops leaks for up to 10 hours until a permanent fix can be made. This technology was designed to be fully functional in 20 seconds, thus reducing environmental impact and cleanup costs. The devices are available in four sizes and compatible with more than 40,000 substances. They offer full fuel and chemical compatibility as well as an operating range of -16°F (-50°C) to 122°F (50°C).

The company says RuptureSeal can safely close breaches, minimize damage, protect the environment, safeguard employees and avoid potentially thousands of dollars in spill mitigation. Deployment of this leak sealant requires no additional tools. The worker would simply compress the silicone pad into the rupture, pull back easily on the handle, and the seal is mechanically fastened in place, even on rough, unclean and splintered surfaces, according to the company. ●

RuptureSeal was designed for the control of chemical and fuel spills, transport containers and saddle tank ruptures, pipe leaks, breaches and for use wherever liquids are stored or used. COURTESY DENIOS-US

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COURTESY BP / KBR

Digital engineering: How integrating technology with human expertise is unlocking new efficiencies

The smart use of digital and data is helping navigate the competing demands of affordability and risk.

ANDY WEBSTER, KBR

Digital transformation has become a key driver of progress in the oil and gas industry. This transformation depends on deploying capital in the most cost-effective way. This article explores how the smart use of digital and data is helping navigate the competing demands of affordability and risk.

Photo (above): KBR played a key role in designing and delivering bp's Azeri Central East (ACE) platform. Leveraging visualization and analysis tools, KBR's engineers constructed a unified 3D digital twin model replicating every feature of the platform in vivid detail. The first production well was spudded from the ACE platform in the Caspian Sea in December 2023.

Rise of digital tech and barriers to overcome

True to Moore's law of doubling microchip capacity every two years, more powerful, less expensive and less cumbersometechnology keeps coming. The potential this offers the oil and gas industry is largely untapped. While technology has eliminated manual work in blue-collar areas, tedious, low-value white-collar work is proving harder to shift.

The solution is emerging in the form of digital engineers and digital engineering. This goes beyond enterprise software and capability, and beyond information management, in terms of deploying software to achieve a mission. The key to digital engineering lies in deploying roles and individuals focused on business outcomes and that are able to work at the boundary of human and digital tasks.

In response, KBR and other companies operating in the project space are investing in growing digital engineering capabilities.

Cloning data

To drive affordability and lower risk, digital engineering is leveraging the ability to clone or replicate engineering design from one project to another. This isn't as simple as copying and pasting. Design and engineering assurance requiring significant technical expertise is essential to understand data and make the right judgements. The emergence of model-based systems engineering (MBSE) is enabling engineers to accurately identify when cloning or replication is appropriate.

In a recent project to build a gas processing plant, cloning

data from a similar project eliminated the pre-FEED stage completely and reduced the FEED stage, cutting the total project duration by months.

Cloud enabling global collaboration

Technology is enabling collaboration in globally distributed, oil and gas project teams involving dozens of organizations. People who are not used to working together, openly sharing, seeing, using and reacting to common data can be key to project success. The technology itself is simple, but sharing work in real time requires emergent digital engineering skills.

In the pre-FEED stage of one FLNG project, KBR created a cloud-based data room for a team working in London, Perth and Chennai. This underpinned a shared understanding that helped to foster profitable engineering decision-making, cutting pre-FEED stage duration by more than 50%.

Digital twinning

As projects progress, shared data becomes the foundation for a digital twin. For digital engineers the term "digital twin" is akin to the term "maintenance planning" for maintenance engineers. It is not about the software; it is simply where the work happens.

KBR worked with software partner Aveva to develop a digital twin of bp's new Azeri Central East platform in Azerbaijan. Throughout the project, digital engineers organized huge amounts of data from many sources, helping the project progress ahead of time as the data matured.

Digital engineering helped the digital twin evolve, offering value in the operational phase. It supported critical training and startup activity, removing months from the project duration. A small team continues to maintain the digital twin, enhancing maintenance, safety and productivity.

Conclusion

These recent examples show what is now possible, and where Moore's law might take us next. For example, the potential with AI is huge, but the technology will only ever be as good as the engineer who wields it. So, as long as the industry keeps investing in the human skills to use digital and data to its full potential, rapid acceleration and risk reduction will be the results. ●

Andy Webster is director of digital at KBR..

KBR designed the living quarters and delivered project management from 2017 to 2020 for the Johan Sverdrup project offshore Norway. COURTESY KBR

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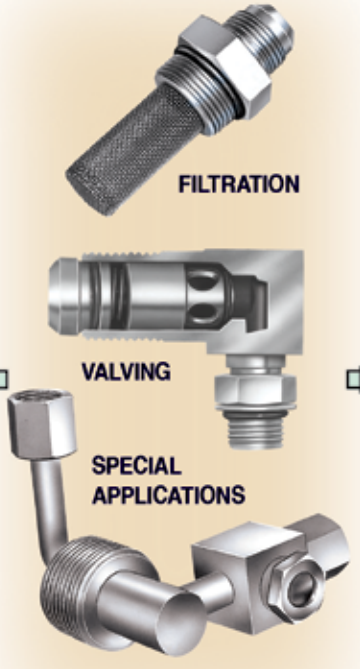

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COURTESY RIGER

HSE software designed to prevent workplace injuries

The benefits of a robust HSE management system extend to every aspect of offshore operations.

MICHAEL MALTSEV and **DANNY LAZOURIEVSKY**, RigER

HSE management is a critical component of the offshore oilfield industry, regardless of the size or nature of the operations. In the high-stakes environment of offshore drilling and production, prioritizing the well-being of personnel goes beyond regulatory compliance—it is a strategic imperative. Offshore operations are inherently high-risk due to remote locations, harsh weather conditions and complex logistics. Organizations that foster a culture of safety and continuous improvement not only protect their workers and the environment but also gain a competitive edge in operational efficiency and innovation.

In offshore oil and gas, safety is paramount to safeguard workers, prevent environmental disasters, and meet stringent regulatory and customer requirements. The benefits of a robust HSE management system extend to every aspect of offshore operations. Streamlined reporting processes and seamless integration with other business systems ensure compliance with offshore-specific regulations and accurate safety data recording. This comprehensive approach mitigates risks, fosters a culture of safety and ultimately enhances the performance and success of offshore operations.

HSE system

Hours and days after the incident, the information about root cause and details of the incident begin to fade from the memory. It is imperative to have a system in place to timely and accurately capture those details. A standardized system, like the following, will accelerate cross regional and departmental training to facilitate data gathering and reporting of workplace incidents:

- Capture the incident information and details;
- Investigate the incident to determine direct and root causes;
- Assign corrective actions and track their completion;
- Analyze affected cost; and
- Verify the investigation results and conclude the incident report.

Outcome of enhanced HSE monitoring

The systematic approach gives the ability to identify clusters of similar type incidents to highlight any recurring issues. In a case study, a client was able capture incident information as

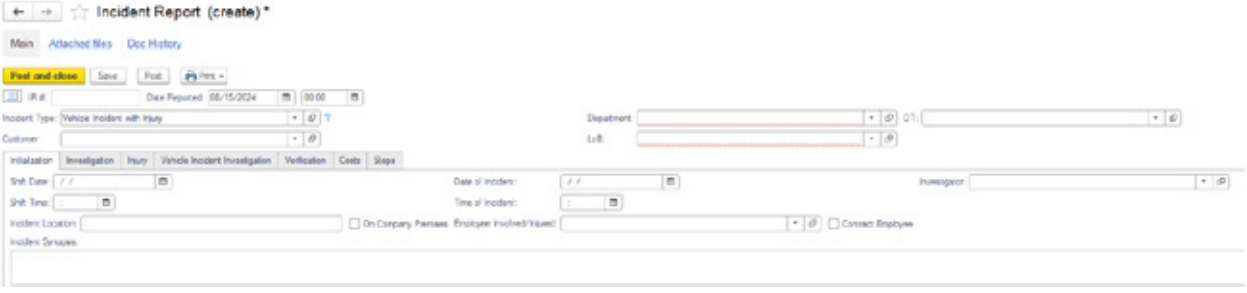


Photo (above): The RigER HSE Module helps sort information by incident type, root cause, direct cause, location and other attributes. COURTESY RIGER

well as identify and resolve the recurring incidents to improve workplace health and safety.

Reporting functions in the specialty software, like the RigER HSE module, help sort the information by incident type, root cause, direct cause, location and other attributes. The client in the case study was able to identify recurring incident types and examine the troublesome location. Corrective actions were taken to enhance training for the line of business at that location and supply the workforce with additional PPE gear that was not part of the base package to mitigate the hazards in the environment.

The HSE module in RigER is managed by the HSE department and access is strictly assigned and controlled to safeguard the data, protect employee confidentiality and conform to OSHA standards.

During the initialization of the incident report, the originator will record attributes such as date, time, location, employee name and incident description. This information will be referenced by the investigator in the next step as they conduct a thorough review of direct and root causes. The investigation is completed, and the corrective actions are assigned. The incident report narrative and synopsis can be shared by the HSE administrator to the management or customer teams through external print forms and stored with limited access in the RigER database.

The final step is generating and analyzing the reports by selecting the incident type, cause, date as an example and sorting by the facility to identify recurring incidents.

Digital oilfield case study

RigER assisted a Louisiana-based oilfield engineering and service company that provides drilling, completions and fracturing services. The company operates multiple lines of business across many departments. Thus, central control and reporting is key to communicating, tracking, reporting and mitigating workplace incidents.

Rental and services dispatch is tied to asset tracking, and equipment is sent and received from offshore platforms and requires rigorous inspections, maintenance, certification and repairs. The company used RigER technology to track each step of the process while operating heavy equipment and machinery to repair and ship equipment to its client. The employee footprint spans across many lines of business, which presents a variety of safety hazards from shop floor operations to transportation and delivery of large equipment. HSE policies were set in place, and RigER technology was used to record, investigate and resolve those incidents. The HSE module allowed users to see trends through reporting and address incidents with high occurrence rates by addressing the root cause.

The process entailed an HSE administrator assigning rights and permissions to keep track of rear and write controls of confidential information. Permissions allow as little access as needed, only reporting an incident to full access to review and verify all details of investigation. Confidential information is isolated with strict read/write permissions that are assigned by the HSE administrator.

An HSE incident is reported to describe the time, location, cause and provide details of the incident. During investigation, a stage person(s) is assigned to discover details behind root cause(s) and determine a corrective action plan. The verification stage completes the investigation process and establishes a record for OSHA, NRC and additional notes regarding the incident.

A cost assessment is recorded after the investigation is completed to capture affect quality improvement plan and provide cost analysis for reporting purposes.

All data is stored from all remote locations in a single cloud application.

As a result, reporting provided visibility to high-occurrence incident types, which prompted new HSE policies to reduce those incidents by 90%, and a standardized incident review process created efficiencies in inter-departmental training. In addition, print forms for internal and customer reporting improved transparency and speed of communication.

In conclusion, having a standardized platform to record and review workplace incidents helped the company keep HSE policies updated. Communications between managers who report the initial incident and the HSE team allowed them to address the issue immediately, investigate the incident and assign a corrective action to improve safety and the wellbeing of its workforce. ●

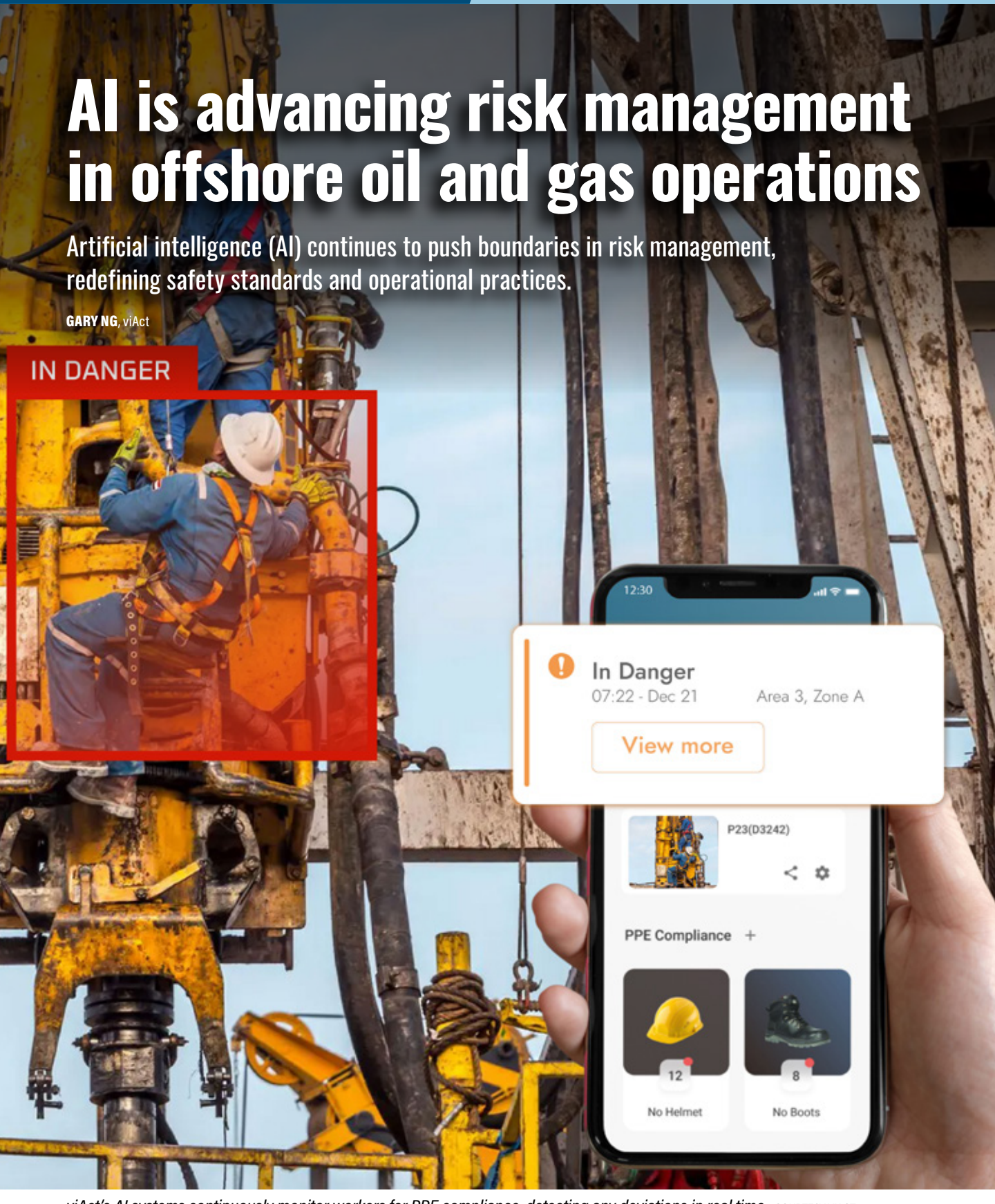
Michael Maltsev is CEO of RigER.

Danny Lazourievsky is the director of product implementation at RigER.

AI is advancing risk management in offshore oil and gas operations

Artificial intelligence (AI) continues to push boundaries in risk management, redefining safety standards and operational practices.

GARY NG, viAct



viAct's AI systems continuously monitor workers for PPE compliance, detecting any deviations in real time. COURTESY VIACT

From volatile environmental conditions to intricate mechanical systems, offshore oil and gas operations are fraught with complex challenges. These amplify operational risks making traditional risk management methodologies often fall short in mitigating these multifaceted threats even though they are foundational. Moreover, anything apart from foundational strategies that are employed to ensure heightened safety and resilience is often seen to cease swift operational transitions.

In an industry where the stakes are exceptionally high, artificial intelligence (AI) is playing a transformative role in offshore risk management. These innovations offer real-time insights, enabling proactive responses to potential hazards, and allow users to anticipate equipment failures before they occur. These AI-driven technologies enhance compliance and safety. With many AI companies integrating AI into offshore operations, the industry is poised to redefine its approach to risk management, ensuring greater safety without impacting operational efficiency.

Offshore safety deployments

viAct, an AI solutions provider from Hong Kong, has recently made many deployments across the offshore oil and gas sites in the MENA region, specializing in visual AI for offshore applications. The company has developed video analytics and AI-driven tools powered by generative AI specifically designed for HSE teams of offshore oil and gas operations. The technologies are designed to enable greater safety and operational efficiency in these challenging environments by enhancing safety compliances with video analytics, and generative AI chatbots can be utilized for instant real-time insights.

viAct's AI-powered video analytics systems continuously monitor workers for PPE compliance, detecting any deviations in real time. Additionally, the system can identify unauthorized intrusions into hazardous areas, such as proximity to heavy machinery or volatile zones. By providing instant alerts for these situations, these technologies enable immediate intervention, preventing potential incidents and ensuring the safety of personnel amid the unique challenges of offshore operations, protecting both lives and critical infrastructure in these high-stakes environments.

In addition, the company's recent development of generative AI chatbots is reshaping risk mitigation strategies by offering precise, real-time insights tailored to the complexities of these environments. These intelligent systems process extensive operational data from various offshore assets, such as drilling platforms and subsea equipment, to identify emerging threats like equipment malfunctions or environmental hazards. By providing instant, context-specific guidance and actionable recommendations, viAct's AI chatbots enable swift decision-making for the HSE team by using a targeted approach optimizing operational efficiency in these high-risk settings.

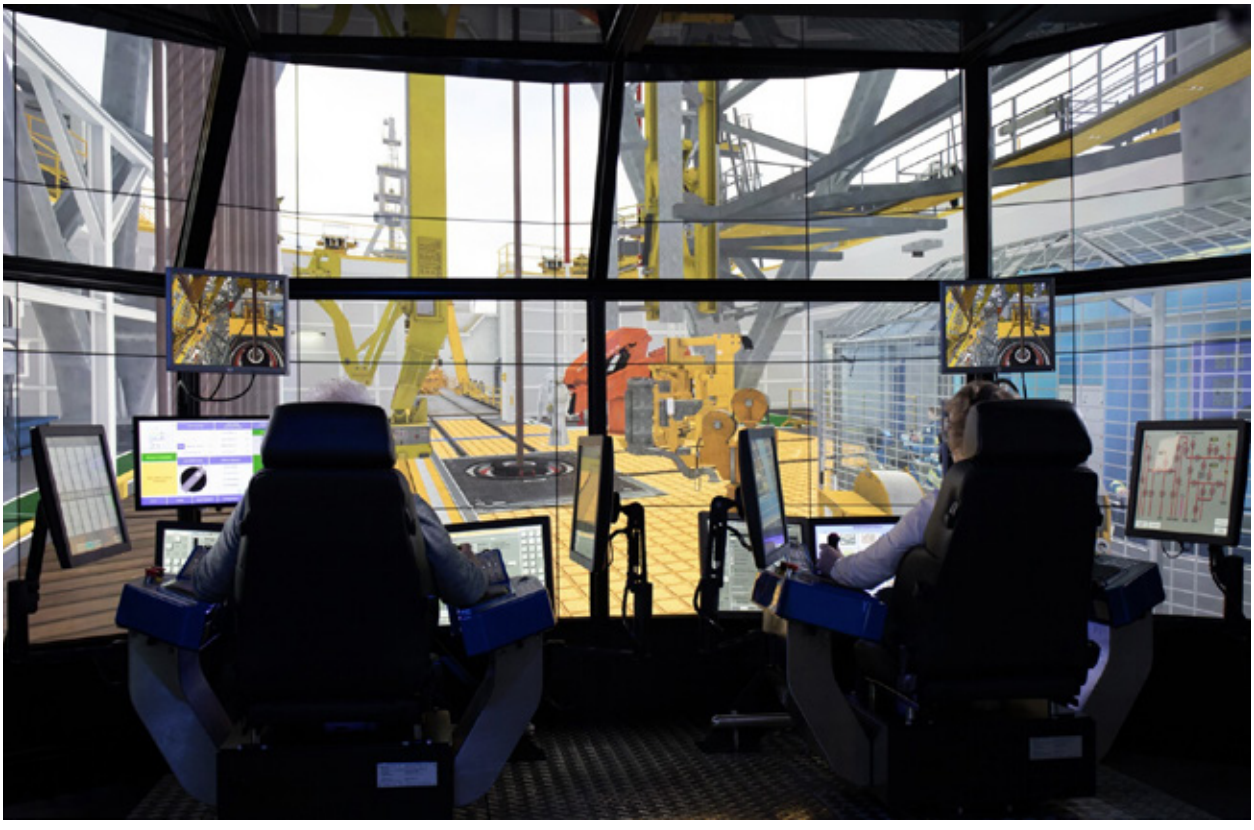
viAct also integrates Internet of Things (IoT) technology into offshore operations refining predictive maintenance through advanced data analytics. IoT sensors continuously monitor equipment health, identifying subtle anomalies before they escalate. This foresight enables precise, timely maintenance, reduces unplanned downtime and optimizes risks related to such downtime, thereby ensuring the seamless and efficient operation of critical offshore systems.

Case study results

An internal audit reports that offshore safety practices have seen siginificant improvements following viAct's deployment. Incident reports dropped by 95%, while PPE compliance increased by 80%. Real-time hazard detection has led to a 70% reduction in near-miss events. Additionally, predictive maintenance capabilities enhanced operational uptime by 75%, significantly boosting overall efficiency.

As offshore operations evolve, AI continues to push boundaries in risk management, redefining safety standards and operational practices. AI is crucial in enhancing safety, efficiency and risk management in offshore oil and gas operations. ●

Gary Ng is CEO and co-founder of viAct.



Bespoke drilling simulators assure operational safety

Advanced simulation training is revolutionizing well intervention in the offshore oil and gas industry.

MAX WYNDHAM, 3t Drilling Systems

Photo (above): The DrillSIM:6000 is a training simulator that provides highly realistic and immersive training environments that accurately mimic offshore drilling operations. COURTESY 3T

The paralyzing uncertainty of the COVID-19 pandemic caused an immediate drop in drilling activity, with the effects felt throughout the industry. Now, over four years on, continued consolidation since before the pandemic and commodity prices have contributed to today's ever-improving picture, with rig contract durations and day rates on an upward trend. Projections see global active rig count increasing through 2025 and 2026, with some reports that the current upcycle will last beyond 2030.

A recent snapshot could view this as growth, but a longer view of history could arguably show this as a recovery from the conditions at the end of 2015.

A complete view of events in the last decade and their impact on our industry's workforce is important, as it demonstrates why the recovered activity has not been delivered by the level of skilled and experienced personnel you would expect.

The downcycles during this period caused compounding difficulties for companies in retaining skilled and experienced personnel. As the industry emerges into a new era, the faces among the crews are different. Many experienced personnel have left the industry or retired altogether.

Utilizing simulator technology for workforce development

Contractors and service providers have been under pressure to expand operations while maintaining high levels of operational efficiency—and without any compromise to safety. The practical reality is that compromises must be made. Personnel need to be

hired or promoted, and acceptable training and experience levels are less than when experience was easier to come by.

Solutions for accelerated training, workforce development and competence assessment are vital in giving the industry flexibility to hire and develop people at the required rate while allowing them to maintain or improve their standards.

Demand for accelerated development has led to an increased need for bespoke simulation. There is increased emphasis on training infrastructure that aligns with a contractor's specific equipment and operating procedures. While simulators for well control have always been a staple in drilling contractors' in-house training programs, drilling and pipehandling operations based on rig-specific equipment and emulated human-machine interface (HMI) systems are now the new global standard. The simulator's Cyberchair is required to offer the same hardware and touchscreen controls as the rig, down to the finest detail.

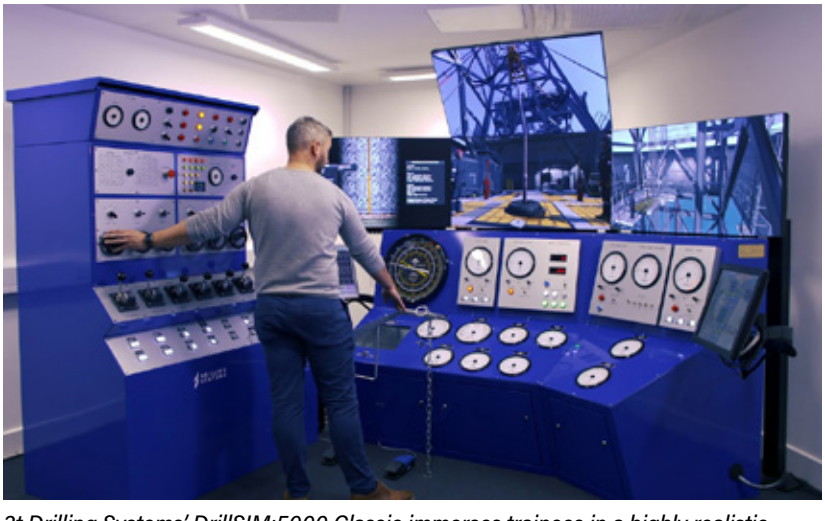
Students arriving from the rig don't want to spend valuable time learning how to use a simulator. Rig-specific controls allow more room to focus on scenarios they don't get exposed to during daily operations. This is typically an emergency or non-routine scenario. For example, getting a BOP landing operation wrong can be costly. However, bespoke simulation facilitates training for the operation by procedure, helping to avoid lost time when performed for real.

For promotion candidates new to a driller's chair or assistant driller's chair, bespoke simulators enable the chance to get comfortable with the controls without worrying about the impact of human error. One ongoing project requires selection between different OEM-specific top drives, which are replicated accurately in the simulator's graphics and HMI system per the manuals.

Movement of personnel between rigs due to growth in activity also triggers demand for rig-specific training as there are so many different systems in operation, and all rigs are slightly different. Besides main drilling equipment, pipehandling and auxiliary operations vary significantly, and dropped pipe incidents can still happen.

Customization of advanced drilling, well control and pipehandling simulation will play a vital role as the industry continues its recovery. Current developments in advanced training simulators are well-positioned to support this trend, and widespread adoption of the technology in all continents demonstrates companies' commitment to workplace safety. ●

Max Wyndham is the head of business development for simulator technology provider 3t Drilling Systems.



3t Drilling Systems' DrillSIM:5000 Classic immerses trainees in a highly realistic environment with a full-size, accurate representation of a conventional rig. COURTESY 3T

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Educational 3D animations replicate real-world offshore oil and gas scenarios

From fire safety protocols to offshore rescue operations, animations translate complex procedures into digestible, engaging content via simulations and interactive modules for trainees.

MOHAMMAD SADEGH AMINI, International Energy Club

In the high-stakes environments of offshore, marine and renewable industries, safety is paramount. These sectors operate under challenging conditions where the margin for error is minimal, and the consequences of mistakes can be catastrophic. As technology advances, so too do the methods for ensuring safety. One such advancement that is making a significant impact is the use of 3D animations, which are designed to revolutionize the way safety procedures are communicated and enhance the overall safety culture within these industries.

Photo (above): International Energy Club's 3D animators have created a comprehensive library of offshore oil and gas industry videos and graphics. COURTESY INTERNATIONAL ENERGY CLUB

Understanding complex systems

Offshore platforms, marine vessels and renewable energy installations are complex structures with intricate systems that require precise operation and maintenance. Traditional 2D drawings and written manuals often fall short in conveying the full scope of these complexities. However, 3D animations provide a visual and interactive representation of these systems, and they make it easier for workers to understand how different components interact and how to operate them safely.

For instance, a 3D animation can illustrate the step-by-step process of shutting down an offshore drilling rig in an emergency. Workers can see the exact sequence of actions required, understand the spatial relationships between different components and grasp the potential hazards at each step. This level of clarity is difficult to achieve with text and static images alone.

Enhanced training and simulation

Effective training is the cornerstone of safety in any industry. However, traditional training methods, such as classroom instruction and static diagrams, have limitations, particularly in replicating real-world scenarios. 3D animations can offer a dynamic and engaging alternative that can significantly enhance training programs.

Through realistic simulations, workers can experience lifelike scenarios in a controlled environment. For example, they can practice emergency evacuations from an offshore platform, navigate through virtual smoke and fire, and learn the best routes to safety. These immersive experiences help to reinforce learning, improve retention and build confidence in handling real emergencies.

Additionally, 3D animations can be used to create virtual walkthroughs of facilities, allowing workers to familiarize themselves with the layout and identify potential hazards before setting foot

on site. This preemptive understanding can reduce the risk of accidents and improve response times in actual emergencies.

Proactive hazard identification and mitigation

One of the key benefits of 3D animations is their ability to identify and mitigate potential hazards before they become real threats. By visualizing processes and systems in 3D, safety professionals can conduct thorough risk assessments and identify weak points that might be overlooked in 2D schematics.

For example, a 3D animation of a wind turbine installation can reveal potential pinch points, areas prone to wear and tear, or locations where workers might be exposed to high winds or falling objects. With this foresight, preventive measures can be implemented, such as redesigning components, adding protective barriers or adjusting safety protocols.

Improved communication and collaboration

Safety in the offshore industry often requires collaboration among diverse teams, including engineers, operators, safety personnel and management. Effective communication is crucial to ensure that everyone understands their roles and responsibilities.

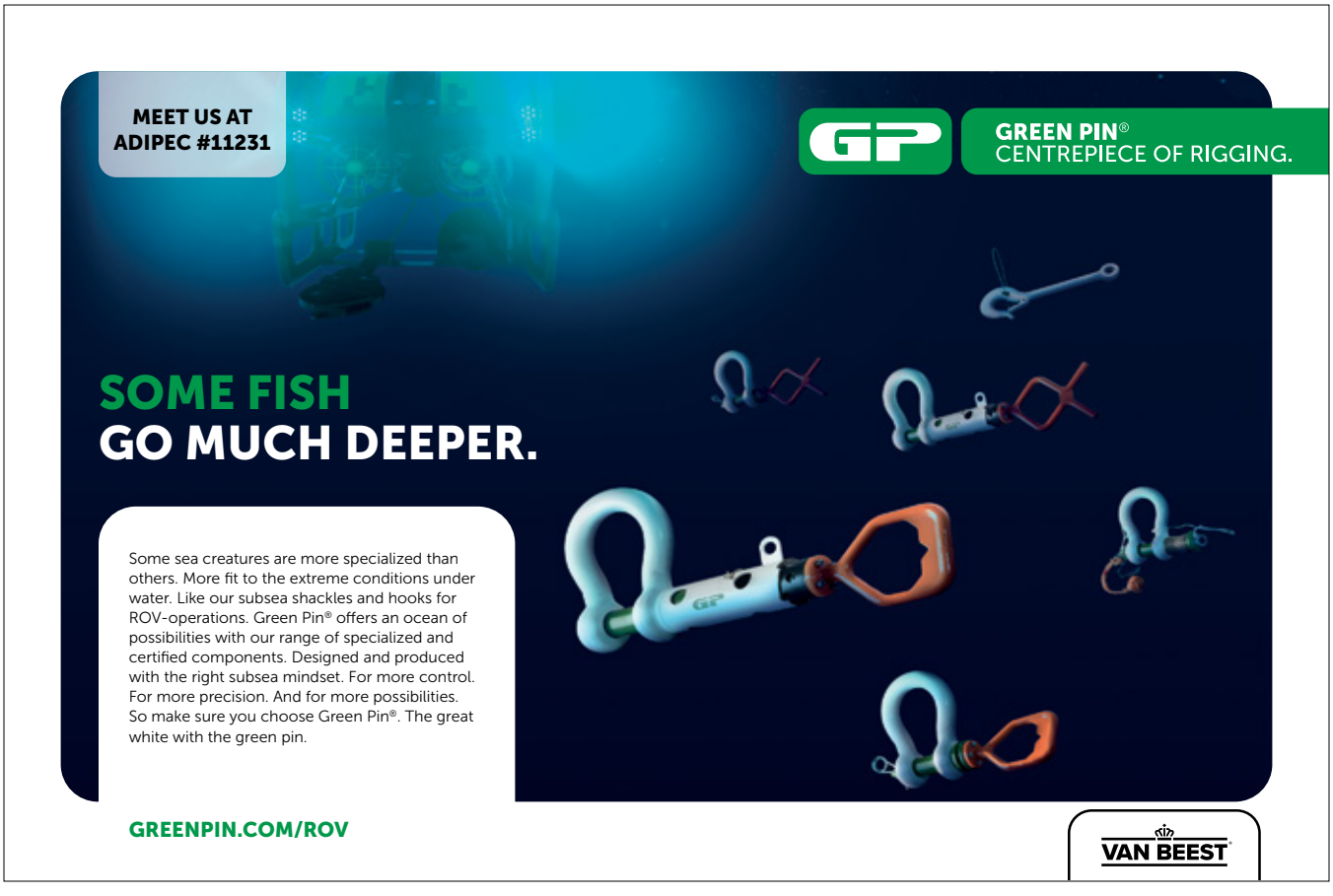
3D animations facilitate this by providing a common visual language that transcends technical jargon and language barriers. When all stakeholders can see the same animated depiction of a safety procedure or system operation, misunderstandings are minimized, and alignment is achieved more easily. This clarity enhances teamwork and ensures that safety protocols are followed consistently across the board.

Conclusion

While creating 3D animations may require an initial investment, the long-term benefits far outweigh the costs. The ability to reuse and update animations as systems evolve ensures that training materials remain relevant and effective. Furthermore, the versatility of 3D animations means they can be used across various platforms, from training modules to safety briefings and even marketing materials.

3D animations are proving to be an invaluable tool in enhancing safety in the offshore, marine and renewable industries. By providing clear, engaging and realistic visualizations of complex systems and procedures, they are transforming the way safety is communicated, understood and practiced. As these industries continue to push the boundaries of technology and innovation, integrating 3D animations into their safety protocols will be essential for protecting lives and ensuring operational success. ●

Mohammad Sadegh Amini is the founder and projects manager for the International Energy Club.



Safety skills, training and innovation will futureproof energy sector workforce

It is critical to equip tomorrow's workforce for the challenges ahead.

EWEN HAY, OPITO

The demand for a highly trained and experienced workforce across global offshore operations grows as the energy industry diversifies, technology advances and net-zero goals become more urgent. From ensuring safe travel to assets, to developing the necessary skills and knowledge in the workforce, it falls to global industry bodies like OPITO to meet this evolving need at scale and at pace. Today's dynamic offshore energy landscape sees the industry at a critical juncture. As global energy demands surge and sustainability imperatives intensify, the sector faces increasing pressure to innovate, adapt and elevate safety standards across all operations.

Key to meeting these challenges is a highly skilled and proficient workforce, equipped not only with technical expertise but also a deep commitment to innovation, safety and environmental stewardship. An equal responsibility from training and standards providers is pivotal to realizing this level of competency, with a critical element being the skillsets required for helicopter travel to and from offshore assets.

Cultivating competence

OPITO's training initiatives are designed to deliver a skilled and adaptable workforce, providing individuals with the knowledge to progress through their career. From emergency response and crisis management to helideck safety, specialized equipment operation and adherence to HSE protocols, these programs encompass a broad range of competencies and are critical to driving a culture of safety, environmental responsibility and operational excellence.

OPITO's Safe Offshore Marine Operations – Offshore Installations & Energy Structures Safety Zone standard enables energy workers to recognize and mitigate potential hazards in and around safety zones. It is designed to equip personnel responsible for marine operations around structures across the energy mix, from oil and gas installations and assets to offshore wind turbines.

Helicopter safety training

This safety focus extends to the transit of personnel to offshore and remote assets—something paramount to the energy industry's integrity. Advanced technologies play a pivotal role here, from sophisticated navigation systems that optimize travel routes to real-time communication platforms that accelerate emergency response times.

OPITO's various training standards for helicopter landing and underwater escape are continuously monitored and updated, equipping offshore workers with the relevant experience and confidence to handle helicopter and marine-related scenarios, tailored accordingly to serve various geographies.

For the Americas region, the Helideck Operations Initial Training (Americas) and Helideck Operations Emergency Response and Aviation Fuel Management Awareness standards were designed and updated to reflect legislation and operational differences in the Gulf of Mexico. These standards offer a minimum benchmark for training in relation to Helicopter Landing Officer competence across the region to ensure the safe operation of helidecks and the safety of workers traveling offshore.

OPITO also has granted greater flexibility for training centers to offer helicopter underwater escape training (HUET) to offshore workers. As the industry embraces sustainable practices and renewable energy technologies, like carbon capture, wind and hydrogen, this needs to be reflected in training modules.

As such, making sure energy workers can achieve relevant training for their roles is a priority. Global training centers can now offer OPITO's HUET as independent approvals, irrespective of offering full basic offshore safety induction and emergency training on site. This move allows global training centers to offer a further variety of courses and passes efficiencies to industry workers, enabling increased mobility and tailored training across different parts of the energy sector. ●

Ewen Hay is the director of products and services at OPITO.

Ensuring safety in the next era of offshore energy projects

Advanced technologies like digitization, automation and AI are enhancing safety and efficiency in the Gulf of Mexico, which is evident in new deepwater and HP/HT projects, as well as CCS initiatives.

ERIK MILITO, National Ocean Industries Association (NOIA)

The offshore energy industry is entering a new era, marked by the integration of advanced technologies like digitization, automation and artificial intelligence. These innovations will help unlock new resource plays and technologies, making operations safer and more efficient than ever. This transformation is particularly evident in the deepwater Gulf of Mexico (GoM), where new projects are breaking ground, highlighting the industry's commitment to safety as it advances into new frontiers.

The integration of advanced technologies has been transformative in recent years. Companies are deploying tools that automate and digitalize operations from the wellhead to the control room, designed to eliminate unplanned downtime, prevent failures, and autonomously overcome and recover from technical interruptions. These processes minimize human error, allowing smarter technologies to operate under human oversight.

The seamless operation of offshore oil and gas facilities is essential for safety and efficiency, and continuous improvement has been witnessed through the application of comprehensive safety management systems.

New GoM projects setting safety standard

A project supported by the National Academies of Sciences aims to improve offshore oil and gas operations in the GoM. Led by Argonne National Laboratory scientists, it uses the Success Path Method, which ensures ultra-complex systems function correctly by focusing on essential components. This method's versatility makes it valuable across various industries, including the GoM energy sector.

In the deepwater GoM, new projects are advancing with innovative techniques. Reprocessed seismic data and 4D seismic technology help optimize well construction and monitor changes over time, improving efficiency and reducing surprises. Infrastructure-led exploration uses cost-effective subsea tiebacks to connect new fields to existing platforms, speeding up reserve access and enhancing safety with standardized designs.

Chevron's Anchor project, which achieved first oil in August, exemplifies the industry's commitment to safety and efficiency. As the first deepwater high-pressure development to begin production, Anchor uses 20,000-psi subsea technology to tap into reservoirs reaching depths of 34,000 ft below the water's surface. Chevron's extensive technology development program for Anchor involved significant investment, rigorous testing and approval by the US Bureau of Safety and Environmental Enforcement. Additionally, the Anchor project has more than 14 million man-hours without serious injury.

Other HP/HT projects are also progressing in the GoM. Beacon's Shenandoah Project and bp's Kaskida Project, which recently reached its final investment decision, are poised to follow Anchor's lead in safe and efficient deepwater development.

Carbon capture and storage initiatives

The offshore industry's commitment to safety extends beyond traditional oil and gas projects. The US offshore energy industry is prioritizing safety in emerging energy segments, such as carbon capture and storage (CCS). Full-scale CCS developments are set to move forward over the next few years in the GoM, with companies focused on making these operations as safe as possible from design through construction and into operations. For example, in a collaborative process, companies are modeling the challenges of supercritical CO_2 downhole in various well control scenarios and conducting material tests for CCS-enabled rig design to ensure safety from day 1.

Despite delays in US offshore CCS regulations, the industry is proactively addressing key safety issues and continues positioning itself for a future defined by innovation, safety and sustainability.

As the offshore energy sector embraces new technologies and continues to make the investments necessary to meet global energy demand for decades to come, its unwavering commitment to safety will continue to set the standard for operational excellence. From deepwater projects in the GoM to the emerging CCS initiatives, the industry is meeting today's demands as well as paving the way for a secure and sustainable energy future. ●

Erik Milito is president of the National Ocean Industries Association (NOIA).

Global oil and gas PPE market set to grow to $9.5B by 2028

Rising investments in offshore oil and gas exploration is propelling the demand for offshore safety systems and personal protective equipment (PPE).

KAPIL GARG and **SHALOM DIVEKAR**, MarketsandMarkets

Rising awareness about the importance of workplace safety and stringent regulations in developed countries is promoting the use of personal protective equipment (PPE), which is used to provide protection against health risks in hazardous work environments

According to the Respiratory Protection Standard, 29 CFR 1910.134, of the US Occupational Safety and Health Administration (OSHA), it is mandatory for employers to have a complete respiratory program. Workers that wear respiratory protection must participate in written respiratory programs and follow OSHA's guidelines, which include medical evaluation, respirator fit testing, and training.

According to OSHA, workplace injuries have witnessed an increase each year in the US. OSHA reported that workplace eye injury costs an estimated $300 million per year in medical treatment, lost productivity and worker compensation. Data from the US Bureau of Labor Statistics also supports the fact, stating that most of the injured workers were not wearing PPE at the time of the accident. A few losses, both direct and hidden costs, occur when a workplace accident occurs. Direct costs are realized at the time of accidents, whereas hidden costs are realized post-accidents.

High energy demands

The increasing population influences the burgeoning demand for energy worldwide. According to the UN World Population Prospects, the global population

is expected to rise from 8 billion in 2022 to 8.5 billion by 2030. Various energy sources, such as thermal, nuclear, renewable, oil and gas, and electricity, are required to meet the growing energy demand.

Regions with high energy demand plan to increase offshore oil and gas production. As shallow-water fields mature, companies are turning their focus to deep and ultradeepwater opportunities, leading to investments in offshore and subsea activities. Oil and gas companies are expanding their search for new reserves, particularly in ultradeepwater areas, including the Arctic. The US Geological Survey's Circum-Arctic Resource Appraisal in 2008 estimated large amounts of oil and natural gas in the Arctic, with the region holding significant undiscovered reserves. This has increased interest and investment in the area, particularly in offshore drilling services.

More offshore operations results in more workers, thus the need for companies to implement HSE strategies and put plans in place to ensure worker safety.

Table 1: Direct And Hidden Costs Of Workplace Accidents

SR. NO.	COST	SPECIFICATION
1	Direct costs	• Medical costs • High compensation • Higher insurance premiums
2	Hidden costs	• Lost production • Training costs • Loss of skills and efficiency • Paperwork involved increases • Legal issues

Source: Secondary Research, Interviews with Experts, and MarketsandMarkets Analysis

Hazardous environments

The oil and gas industry faces different types of risks and hazards, thereby giving rise to serious accidents that might adversely impact people, assets and the environment. Safety is the most critical concern in the oil and gas industry. However, the lack of proper safety systems in this industry may lead to production loss, stress on affected components and systems, and hazards during system restoration.

Oil and gas drilling and servicing activities are undertaken in hazardous environments, which mandate the installation of safety systems for such activities. Oil rig activities can be hazardous and lead to major accidents, with potentially severe consequences for workers' lives and health, environmental pollution, direct and indirect economic losses, and the deterioration of energy supply.

The inherently hazardous nature of oilfield operations necessitates rigorous safety measures, and digital technologies can offer a robust framework to enhance safety protocols. Industrial safety systems are designed to eliminate or reduce the after-effects to a minimum level if any emergency situation arises at a facility or plant. Real-time monitoring through sensors and IoT devices allow for immediate detection of anomalies or potential hazards, enabling swift response to mitigate risks.

Regulatory framework

The regulatory framework surrounding oil and gas safety has evolved significantly to adapt to changing industry needs and to enhance safety standards. Governments and regulatory bodies worldwide are placing greater emphasis on pipeline integrity and the prevention of incidents. This includes developing and implementing more stringent regulations, bars and guidelines governing offshore inspection and monitoring practices.

In the oil and gas industry, standards such as IEC 61508, IEC 61511, and the Norwegian Oil and Gas guideline 070 provide recommended frameworks for implementing industrial safety. Additionally, there is an increasing focus on risk-based approaches, incorporating advanced technologies and data-driven methodologies to assess and manage offshore infrastructure integrity. Advanced analytics and predictive maintenance further contribute to proactive safety measures by identifying potential equipment failures before they occur. Additionally, the use of automation and robotics reduces the need for human intervention in high-risk tasks, minimizing the exposure of personnel to dangerous environments.

The evolving regulatory framework aims to foster a proactive and systematic approach to safety, ensure continuous improvement, and reduce the potential for failures and environmental impacts.

Market outlook

The global oil and gas PPE market is estimated to grow from $7.68 billion in 2023 to $9.59 billion by 2028, at a CAGR of 4.5% during the forecast period. This growth can be mainly attributed to rising global energy demand, especially in emerging economies, which has spurred offshore exploration and production investments. Offshore reserves frequently hold substantial quantities of oil and gas, rendering them appealing for addressing the growing energy requirements. According to S&P Global Commodity Insights, there is an increase of 11% in spending on exploration and production in 2023, with a 20% increase in offshore activity. In addition, governments and energy companies are increasingly recognizing the potential of offshore fields to meet rising energy demand.

Workers involved with oil and gas operations are exposed to serious life-threatening hazards such as harmful chemicals, gases, vapors and fumes as well as the risks of falls, burns, fires, explosions and vehicle accidents. In offshore drilling, there are increased risks of blowouts and the release of hydrogen sulfide and formaldehyde, threatening those working at such locations. Additionally, workers are exposed to high risks of noise-related hearing loss. These risks emphasize the need for specialized PPE in the oil and gas industry.

To prevent workplace incidents, associations such as OSHA, the Information Security Education and Awareness, the National Fire Protection Association, and the National Safety Council mandate workers in the oil and gas industry wear PPE such as helmets, gloves, footwear, protective clothing, safety glasses, ear plugs and respiratory guards. ●

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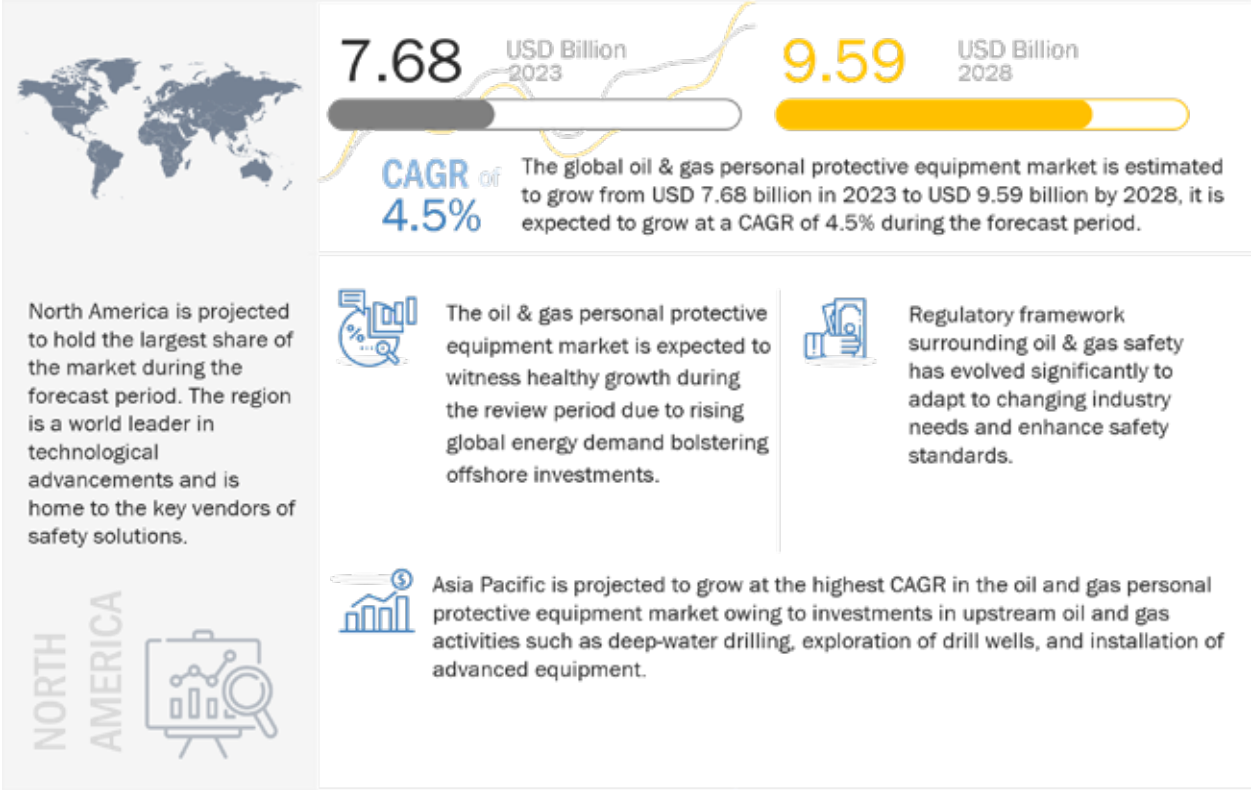

Oil & gas: personal protective equipment market, by region, 2022–2028

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