THE FUTURE OF AI IN TERMINALS

With companies scrambling to incorporate artificial intelligence in almost every facet of their business, is it too soon for critical infrastructure to make use of this tech?

> ARTIFICIAL INTELLIGENCE (AI) is being widely used in almost all industries. Digital tools have been on a steady incline in terminals for the last few years, facilitating training, streamlining work and even predicting maintenance issues ahead of time, but does AI have a place in the tank storage sector?

Dijam Panigrahi, co-founder and COO of GridRaster thinks so: 'The role of artificial intelligence is driving a fundamental shift, moving beyond the digital realm and into the physical world of tank storage terminals. This convergence of advanced robotics and generative AI is ushering in the era of physical AI, transforming it from a software utility into the operating system for infrastructure, and fundamentally reshaping the management of bulk liquids.'

He continues, explaining how AI can be used to improve operations at terminals: 'AI enhances safety and compliance by monitoring for hazardous anomalies, offering leak and spill detection, and streamlining regulatory reporting. For operational optimisation, AI algorithms are crucial in complex material accounting like mass balancing and reconciling conflicting sensor data to ensure accuracy and minimise material losses.'

But will it have a permanent place in the tank storage sector? According to Dr Selin Calik, global strategist of energy risk and ESG at Women in Smart Energy UK, the expected deployment of artificial intelligence could transform storage terminals. 'Industry benchmarks from the World Economic Forum, McKinsey Global Institute and ISO 55000 frameworks show that AI can reduce unplanned downtime from around 12-18% of annual operating time, to 3-7%, cut equipment failure rates by 30-45%, and improve early-stage incident detection by 60-80%. This shift enables terminals to operate with far greater precision, resilience and confidence, while significantly enhancing safety and environmental performance.'

'AI will increasingly power real-time ESG and emissions monitoring systems, making transparent regulatory reporting a standard feature of terminal operations.'

COST EFFECTIVE

Deployment of any new technologies can be expensivee, and AI is no different. But according to Calik, although upfront system integration costs can be significant, most industrial deployments achieve a return on investment within 12-24 months. 'From a financial perspective, AI has proven to be highly cost efficient when assessed over the full asset lifecycle. Data from PwC infrastructure digitisation models and McKinsey asset performance management studies show that AI-enabled predictive maintenance can reduce annual maintenance costs by 20-35% compared to traditional schedules,' she notes.

Panigrahi adds that AI is highly cost-efficient in the long term, primarily by eliminating the high cost of unplanned events. 'Integration can reduce overall operational costs by up to 20%. The key to this cost efficiency is the prevention of unexpected downtime, which is financially catastrophic in the midstream sector,' he explains. 'The oil and gas industry faces average yearly losses of $149 million (€127 million) from unplanned downtime. By adopting predictive maintenance, some major companies have been able to reduce unscheduled downtime by 20% and cut maintenance costs by 15%. Averted downtime alone is a massive return on investment; a short, single-day interruption can easily lead to losses exceeding $1 million (€857,600).'

THE AUTOMATED FUTURE

Whilst many terminals have been slower to adopt new technologies, there is still a large chance that AI will be incorporated into daily operations in the future. 'Looking ahead, AI is expected to evolve from a support tool into a fully integrated operational intelligence layer,' says Calik. 'Projections from the World Economic Forum, IEA and DNV Energy Transition Outlook suggest that by 2030, 60–75% of major global storage terminals will operate AI-driven digital twins that simulate asset behaviour in real time. Autonomous inspection drones and

'AI has the potential to contribute to many other applications and challenges facing the industry today, such as the energy transition, by providing algorithmic forecasting and optimisation.'

robotics are expected to handle more than 50% of hazardous inspections, while AI-driven emergency response models could improve response effectiveness by 40-60%. At the same time, AI will increasingly power real-time ESG and emissions monitoring systems, making transparent regulatory reporting a standard feature of terminal operations.'

So, the future of AI in the storage terminal sector is evolving from simple prediction to autonomous action and resilience, improving not only safety and efficiency, but even helping terminals comply with regulations. 'Future systems will be sophisticated, proactive decision-making tools. AI will move beyond simple detection to create a comprehensive health scorecard for every tank, transitioning from time-based maintenance to data-driven, intelligent prioritisation of activities,' says GridRaster's Panigrahi. 'General-purpose robotics will become common for inspection. Autonomous robots will perform non-destructive testing (NDT), monitoring vast surfaces quickly and accurately, and feeding this data directly into the digital twin for real-time analysis.'

WORKING COHESIVELY

It's all about technologies coming together, enabled by AI, to create a terminal that can almost run itself. But

LEADING THE WAY: DIGITANK

What might the terminal of the future look like? Which technologies will define operations? How will the workforce interact with an increasingly digitised terminal infrastructure? In early 2025, Evos launched DigiTank, a research initiative to revolutionise tank storage logistics and answer these questions. The four-year project, funded by the German Federal Ministry of Transport's IHATEC programme, seeks to reimagine terminal operations so that they become more digital, safer, sustainable, and human-centred.

'DigiTank unites industry partners and research institutions to integrate established technologies such as digital twins, intelligent algorithms, AI, and robotic systems. The ambition is to unlock synergies between these technologies and to leverage the analytical power of intelligent and, over time, self-learning models,' says Verena Staab, project lead at DigiTank.

The programme seeks to reduce control room stress, boost safety measures and optimise operations, turning a terminal into a modern, state-of-the-art facility. Its success will not only drive technological advancements but also improve the mitigation of environmental risks, ease worker burdens and support sustainable practices.

'Terminal infrastructure across Europe is being progressively digitised, enabling the remote monitoring of an increasing number of signals and the partial remote control of operations,' says Staab. 'Tasks that were once entirely dependent on manual execution and therefore more susceptible to error can now be supported by automation or be fully automated.'

Hear more from DigiTank at StocExpo at the Rotterdam Ahoy on 10 & 11 March.

that's not to say human intervention and supervision won't be needed – while automation can reduce the risk of human error, there will still be elements of a terminal job that only a real person can do. The question is whether the workforce is able to upskill quickly enough to know when and how, or even whether, to use AI and other technologies.

Verena Staab, project lead for Evos Hamburg's DigiTank initiative (read more about that in the box above) explains that as terminals adopt more digital solutions, operators must monitor an increasing number of signals and alarms 24/7. 'This environment requires rapid identification of critical information within a high density of signals. Research shows

that such environments significantly increase operators' mental stress and the speed at which interventions and measures are taken. In our industry, these misjudgements can have serious consequences for people, the environment, and operations,' she says. 'Meanwhile, the sector is having difficulty attracting enough qualified candidates for safety-critical roles. Although automation can reduce some of the workload, future professionals will need to master a broader range of tasks and responsibilities.'

Staab reflects on the lessons learned (so far) from DigiTank, and looks to the future of work with this technology in mind. 'Algorithms, AI and robotics are increasingly seen as important tools for making the tank storage sector more resilient, safer, and more productive,' she says. 'The goal is to create an intelligent workplace that reduces staff's routine workload while improving safety. AI-supported systems can automate routine decisions and provide robust decision support for operators in complex situations. In addition, AI has the potential to contribute to many other applications and challenges facing the industry today, such as energy transition, by providing algorithmic forecasting and optimisation.'

For more information:
www.evos.eu
www.gridraster.com
www.wisenergyuk.com

REGULATIONS IN EUROPE

The European Commission has presented a new set of measures that should enable Europe's businesses to spend less time on administrative work and compliance and more on innovating and scaling up. It opens opportunities for European companies to grow and lead in technology, while upholding Europe's standards of fundamental rights, data protection, safety, and fairness.

The measures could save businesses up to €5 billion in administrative costs by 2029. Additionally, the European Business Wallets could unlock another €150 billion in savings each year.

Efficient implementation of the AI Act will benefit society, safety and fundamental rights. However, it requires clear guidance and support. Companies will only have to apply the rules for high-risk AI systems once the necessary support tools and standards are in place. This gives them up to 16 months to comply. This initiative also proposes targeted amendments to the AI Act, including simpler rules, opportunities for real-world testing and centralised oversight of AI systems.