DEMYSTIFYING DIGITALISATION

Danny Constantinis, EM&I Group, Malta, examines digitalisation and AI in asset integrity (AI)^2, with the purpose of understanding its capabilities, challenges and advantages within the industry.

To parody a comic line from a 1979 cult film… what has 'digitalisation' ever done for us? That is, apart from giving us Artificial Intelligence (AI), machine learning, botnets, digital twins, and a generous helping of digital mischief in the form of malware.

How do we navigate the deluge of data, mounds of technical information, and febrile marketing surrounding digitalisation, and the rapidly evolving technology of AI and its applications? Especially as the media, conferences, and online debates are more inclined to generate heat than light, leaving the recipient dazed and confused. How do we distil the vast array of information we encounter into meaningful and impactful insights?

This article aims to demystify digitalisation by sharing the conclusions that EM&I came to after correspondence with fellow asset integrity management specialists. It aims to examine the topic of digitalisation and AI in asset integrity (AI)², with the purpose of understanding its capabilities, challenges and advantages within the novel areas of the industry.

What is meant by digitalisation and (AI)²

Digitalisation in the energy sector, particularly in oil, gas, and renewables, implies the use of leading digital technologies to optimise aspects of energy generation, transmission, distribution, and consumption. In asset integrity, digitalisation helps to monitor, verify and maintain the health of physical production assets, ensuring they operate efficiently and safely. This involves using intelligent sensors, the Internet of Things (IoT) devices, advances in connectivity and advanced analytics to detect issues early, to monitor, and to perform maintenance proactively.

These technologies are now increasingly possible and therefore capable of being 'industrialised' and commercialised through the declining costs of sensors and data storage, and greater connectivity with faster and cheaper data transmission.

Figure 1. Live pre-dive checks and subsequent UWILD ROV dive on an FPSO 200 km offshore, performed by a ROV Pilot at EM&I's Onshore Command Centre at Macaé in Brazil.

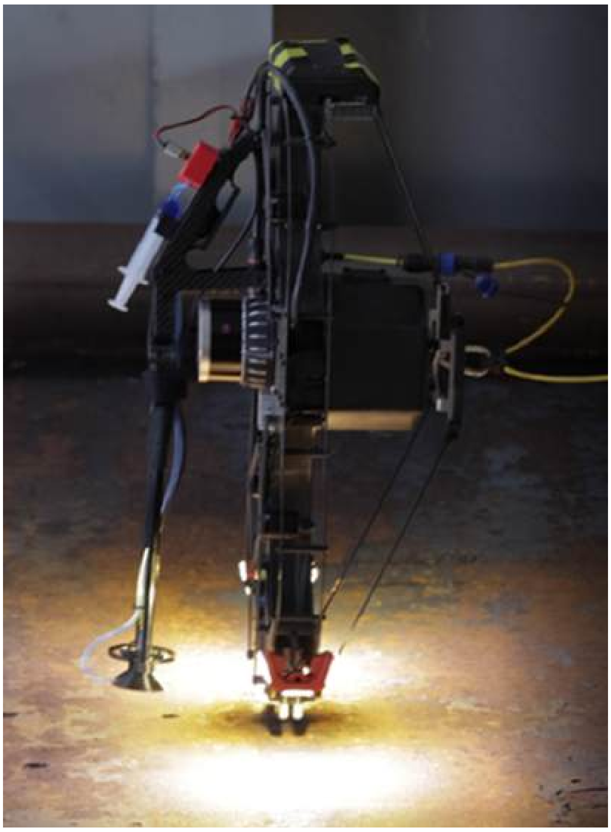

Figure 2. EM&I advanced inspection drone performing UT gauging, with A Scan, beyond visual line of sight, tethered, inspecting a cargo oil tank – remotely.

Yardsticks for (AI)²

Digitalisation and the associated technologies are moving at a great pace. There are four 'yardsticks' that have been determined, against which companies can measure their investment and effort.

Situational awareness

Inspection is about placing the right 'sensor' in the right place at the right time. Until recently the vehicle carrying the 'sensor' mattered less. But the opportunity afforded by (AI)² to significantly extend the range of the carrier vehicles has changed the paradigm. The possibilities afforded by (AI)² – greater, cheaper connectivity and advanced analytics – provide a quantum leap for remote inspection, in turn providing less of a requirement for dangerous diving operations, fewer bedspaces required on offshore production platforms, and many other planned benefits.

Figure 1 depicts one of four work stations at the Macaé Onshore Command Centre in Brazil conducting simultaneous UWILDs. It depicts a ROV Pilot conducting pre-dive checks on a floating production storage and offloading (FPSO) facility 200 km away, and then a live dive. The environment is clean, uncomplicated and does not look anything like a space control centre – deliberately. What is not seen is the experienced senior inspector roving behind the seated pilots looking at imagery and occasionally prompting the pilot for a different view or measurement. The regional operations manager is also not seen looking at the performance of the ROV teams and able to step in to assist in the event of an incident or crisis.

Overall, the company was pleased with the improvement in the quality, accuracy, and efficiency of what is delivered to clients. The exploitation of (AI)² will continue to seek solutions to other problems, notably improved situational awareness for its ROV and UAV crews conducting complex remote inspection work in challenging environmental conditions. Figure 2 shows an inspection drone using a range of technologies that includes LIDAR so that the pilot is safely operating the drone from outside the tank.

Learning, experience, and prediction

In assessing the application of a technology, it can be helpful to ask the question 'what do we wish to learn?'.

If the 'need' is to learn, then (AI)² with associated learning algorithms provides an effective, attractive option for processing the huge mounds of data that underpin that. The availability and quality of survey simulators is on the rise, as an example, spawned possibly by the potential of digital twin technology. It is now possible to train a class surveyor in many aspects of the art of survey without the necessity of frequent and expensive offshore 'learning'.

These advanced simulators, particularly those using advanced augmented reality technology, provide a detailed and realistic 3D representation to familiarise surveyors with the range of offshore production assets (FPSOs, FLNG and FSRUs) they may encounter during their career. It is now possible to teach a range of skills that might otherwise take years to acquire. The International Association of Classification Societies (IACS) provides guidelines for assessing the condition of protective coatings in ballast tanks. The condition of the coating is typically categorised as good, fair, or poor based on visual inspection and the estimated percentage of areas with coating failure and rusty surfaces. A modern training simulator that uses learning algorithms can depict an area of a tank (Figure 3) and show that same area under different levels of coating condition; and describe how that might be reported.

Where the task involves 'predicting' an outcome, (AI)² is useful in managing the 24/7 dimension of data collection, interpretation, rapid analysis and presenting predictions and options – the algorithms rarely tire. One recent and exciting example of this 'prediction' capability is detecting defects, such as cracks and pitting, that are not yet visible to the human eye.

Asset integrity tasks that feature aspects of learning, experience and prediction may provide the focus for future (AI)² and are therefore deemed to be 'yardstick' criteria.

Commercially viable and secure

One important, if self-evident, yardstick is commercial viability and security. The task must be commercially viable from an early stage if the benefits are to merit the potential costs (money, resources, time) and overcome the corporate 'resistance to change' that is sometimes endemic in organisations. Projects that meet the yardsticks (improve situational awareness, promote learning, experience and prediction) must be quickly and robustly 'scrubbed' to validate their relevance.

In assessing the commercial viability of an (AI)² project, investors are aware of the 'rebound effect' – a reduction in the anticipated gains or benefits. This can be balanced by a powerful (AI)² phenomenon: the 'accelerative' effect, which is what happens when one transformative innovation spawns the next. This is not simply a form of competitive pressure.

EM&I introduced its ODIN® inspection ports to inspect in-production critical sea valves using high performance cameras. Clients asked if the company would be able to isolate and repair those same sea valves found to be defective through the same ODIN inspection port. With (AI)², this effect is even more marked. Upon the introduction of the inspection drone equipped with superior situational awareness algorithms, clients requested its deployment for cleaning critical inspection areas.

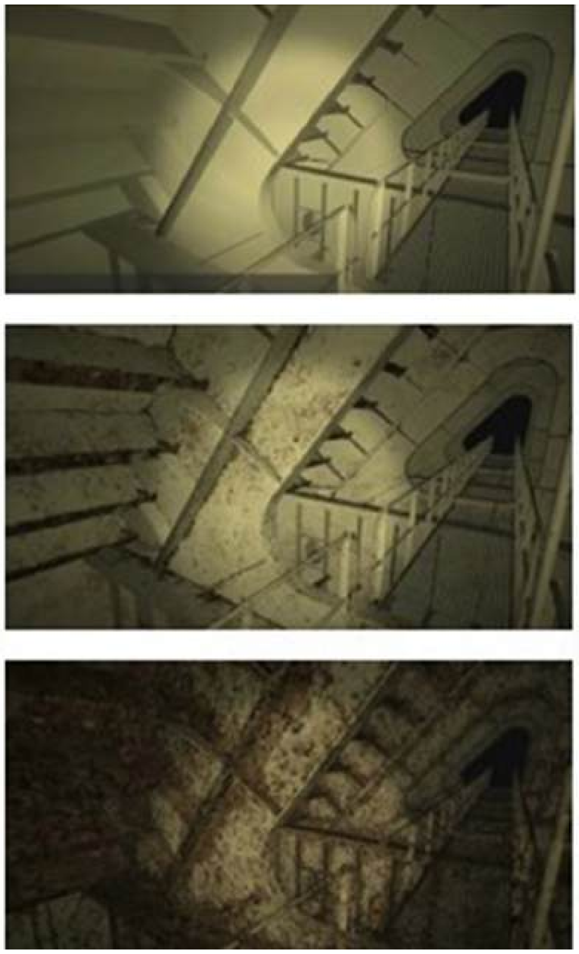

Figure 3. Images drawn from a survey simulator used to replicate a deterioration in coating condition from good to poor (top to bottom).

Cybersecurity is one important factor that merits special consideration as it can add significant extra cost. The advent of sophisticated ransomware provides a very real and present danger to a range of offshore operations. Whether it involves seizing control of a drillships thrusters, or jamming to disrupt communications consideration must be given to the whole lifecycle cost of developing an (AI)²-enabled system or application.

Conclusion

Digitisation presents a myriad of possibilities of digitalisation in the world of asset integrity. Despite the enthusiasm, it has become increasingly evident that AI in (AI)² is not a universal solution or panacea to all challenges. In the context of asset integrity within the energy production sector, the adoption of (AI)²-enabled technologies must be approached with a clear and rigorous understanding of their purpose and intent – the 'yardsticks'. This suggests that while these technologies offer exciting possibilities, their implementation should be guided by a thorough understanding of the specific problems that they are intended to solve, ensuring that their application is both meaningful and effective. T&T