The Future of Optimised Underwater Asset Management

Matthew Curtain
[1] ROVing Intelligence Melbourne, Australia; matthew.curtain@rovingintelligence.com

Summary
The future of optimised Underwater Asset Management is in the creation of a "Digital Twin" of the real-world asset that is regularly surveyed and compared against the MASTER Profile, providing a reliable "heat map" indicating the maintenance work that needs to be undertaken. This will form the backbone of a future Port Master Plan.

Keywords: Asset, Digital Twin, Underwater Robotics Survey, Ports, 3D modelling, AI

Introduction
The maintenance Plan for most Inland and Coastal Waterways including Ports, extends into the tens of years and many hundreds of millions of dollars. This is often a result of the MASTER reference data being poorly catalogued and being very much out of date. Every dollar spent on maintenance is a dollar not spent on future infrastructure. Well managed/maintained Infrastructure leads to improved port operations and the competitiveness of each state, shire and council in helping their region attract more of the finite Government and Commercial Investment dollar. What is it that we could do to help improve the reliability of the maintenance spend and the end to end (E2E) (cradle to grave) process?

Figure 1   Optimising the UW Asset Lifecycle

Baseline Maintenance Data
As we have completed research around multiple inland and coastal waterways, we have confirmed a long list of dated underwater assets. In doing this, we have also discovered extensive evidence that asset owners do not have reliable MASTER Data references. Furthermore, their Asset Maintenance Plans are at best prioritised guesses around targeted diver surveys, Wharf Structures Condition Assessment Manual (WSCAM) Reference Data and a local photographic library.

Furthermore, honest conversations with local engineers support the fact that much of the data is never really reviewed properly. With limited resources and a finite budget, many maintenance plans are "hit and miss" and certainly not well planned. Worse still is that the Asset Register is often unreliable and certainly not complete.

Thinking Differently
As the summary suggests, what if we could overhaul the entire Underwater Asset Maintenance Process to create a MASTER set of data? A set of data that we could rely on and is readily updated at regular intervals.

The idea of a Digital Twin is not new, but it has not been well adopted outside of the Commercial Oil and Gas Industry and the more progressive Port Operations around the world. While much more readily adopted in above water assets the UW Digital Twin would become the MASTER Baseline data set for everything below the water line.
This concept is easily adopted for new asset builds. However, with some considered planning and a radical shift in thinking we could make significant progress across our various historical assets in a short period of time. The solution doesn't wish to challenge the value of dedicated commercial divers doing their very specialised underwater work. Rather it will enable the fast tracking of historical data "log jams". This will facilitate the production of a new Baseline Reference Data set (Digital Twin) for assets where the data has been left to outdate and become unreliable. This data can then reliably be used for future Asset Management Planning.
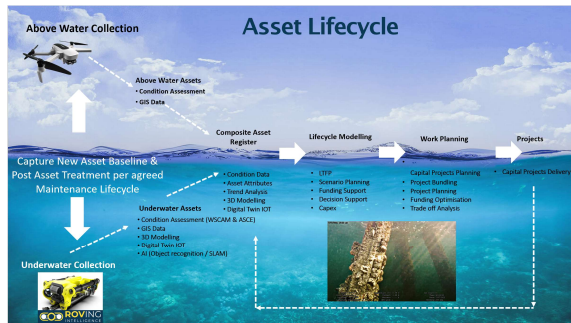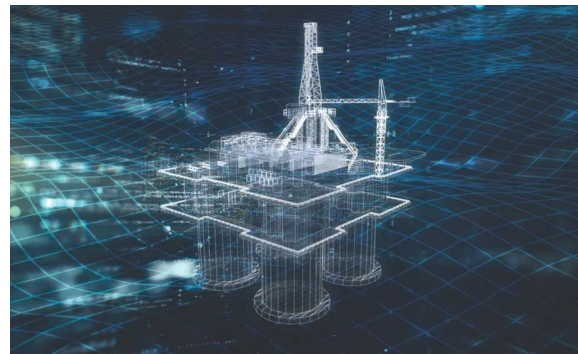

Figure 2 The Digital Twin Concept of an offshore Oil Platform

Good maintenance Planning requires a reliable MASTER Data set. With an updated Asset Register we can begin long-term maintenance planning. Therefore, if we could survey an entire Asset within a few days and create a "Digital Twin" with the use of the latest technology in Underwater Robots, then we could significantly improve our baseline data. Key Data points would include:

- Reliable Underwater Video and High-Definition photographic imagery
- Accurate Geo-Positioning Data (including Sonar Data)
- LIDAR – 3D
- Photogrammetry
- Asset Laser Scaling Data
- Asset Thicknesser Testing Data
- Asset Biofouling Growth Sampling Data
- Water & sediment sampling
- Etc.

If this data can be easily referenced back to existing WSCAM data sets and extracted back into the local Asset Register, we have our starting point. With good planning and the right technology, we could realistically complete the survey of most underwater assets within a one to two year timeframe. If the same survey is repeated every couple of years, the data will quickly become very reliable, easily referenced and trends can be identified. From here our Maintenance Plans can be more reliably optimised.

Once we have baselined, we can then more readily share and update our WSCAM Data. Most importantly we have the baseline for quality Machine Learning and Artificial Intelligence (AI) that more accurately guides our Maintenance Planning. Furthermore, we will be able to "heat map" and provide targeted expenditure of our precious maintenance dollar. If we do NOT have to spend then we DON'T spend. Equally we do not have to take as many unnecessary risks and wait for catastrophic accidents to guide our maintenance spend.
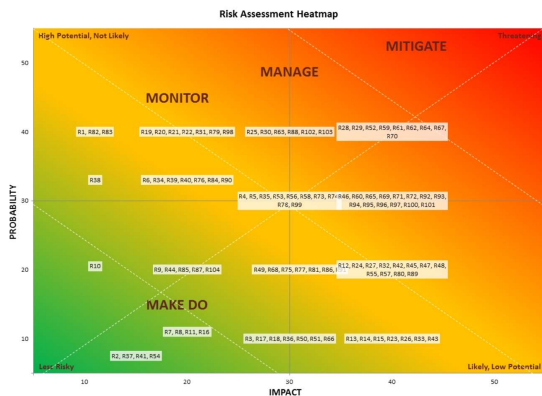
Figure 2   Planning the Maintenance Spend

Outsourcing the Service
When faced with the challenge of accelerating Asset Maintenance uplift there are 2 options. Option #1 is to develop an experienced team who undertake the work or Option #2 look at an established and credible outsourced service that specialise in inspections and condition assessments.

The argument for the first is relatively simple but very expensive. Dedicated resources (People and Equipment) will need to be acquired, maintained and always working the problem. The challenge with this model is in staying current with the fast-moving technology.

Option #2 is outsourcing the annual Asset Survey to a partner with an appropriately certified UW Asset Inspection team to make best use of Underwater Robots they then have responsibility for staying abreast of the rapid changing technology and have responsibility for collecting and interpreting the data before populating the Asset Register. The data required and the inspection cycle will be the only demand on the customer as this data will feed the E2E maintenance planning cycle. This means that Port Engineers are free to focus on the front end "value add" Projects that add to the Productivity agenda of the organisation.

Conclusion
Often professional Underwater Asset maintenance has been neglected for years. Few waterways, in Australia are currently optimising their Maintenance spend, or fully on top of their full register of assets. Sadly, the worst of the neglect is when treatment is only finally realised after an expensive asset failure. Money wasted in maintenance detracts an operation from investment in a Growth Portfolio of Projects leading to greater National, State and Municipality competitiveness. Improvements in technology and process provide an opportunity for all participants to think differently on how this can be achieved. However, taking no decision is NOT an option as our collective assets continue to age.

Risk Assessment Heatmap