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DRIVING INNOVATION PRODUCTIVITY AND EFFICIENCY

ESSENTIAL DIGITAL INVESTMENTS FOR THE WATER INDUSTRY

Digital technology can save time, resources and money while increasing productivity and efficiency. Water companies have already started to embrace digital solutions, however further investment is needed if the sector is to meet tough performance targets and adapt post-pandemic, says digital specialist **James Leverton**.

There's never been a better time for water companies to further embrace digital solutions. Not only are water regulators across the UK and Ireland setting tough efficiency and performance targets over the next regulatory period, but the use of virtual tools is becoming more commonplace in the face of coronavirus restrictions.

Digital technologies can improve capital delivery efficiency and optimise operation and maintenance costs in both the short and long terms. But implementing a digital strategy can be a daunting prospect and investments need to be worthwhile. For example, it can be difficult to justify the investment in digital tools for smaller schemes — but not when you consider that those same tools can be scaled across a programme of similar projects leading to numerous benefits in this regulatory cycle and the next.

To encourage uptake and share best practice, BIM4Water, a cross-industry group open to all organisations involved in the management and delivery of water and wastewater assets (including AECOM), was set up in 2013 to lead digital transformation and drive standardisation across the industry.

> "IN THIS ARTICLE, WE IDENTIFY WAYS TO INVEST WISELY, HIGHLIGHTING THE MOST EFFECTIVE DIGITAL TOOLS AVAILABLE."

In this article, we identify ways to invest wisely, highlighting the most effective digital tools available and looking at how technologies can be layered on to improve efficiencies according to the need and scale of a project or programme.

DIGITAL ESSENTIALS FOR ALL SCHEMES

For companies at the start of their digital journey, we make the following three recommendations.

Common data environments

A common data environment (CDE) is the foundation for projects of all sizes. CDEs enable clients, designers and anyone in the supply chain to access all project information, such as the latest drawings and documents, at any time throughout the duration of the project and beyond.

Setting workflow parameters means everyone involved in the project gets the right information at the right time. For example, the client can access the designs only once they have been through all the necessary stages of approval and are ready to be used.

Standardisation

International standard ISO 19650 and the current PAS 1192 suites of BIM standards address how companies should organise and digitise information about an asset.

The standards ensure that every piece of information is structured correctly so that it can be stored in the right place and in the correct format, which improves collaboration across delivery teams and reduces potential costly rework when delivering the asset.

Digital design reviews

Moving to digital design transforms how designs are created and presented — for the better. Traditionally, designers and water companies work with two-dimensional (2D) drawings at the development stage. However, working instead with 3D models brings huge advantages. For example, rather than labelling each detail on a drawing, information about every pipe or valve can be easily obtained just by clicking on the relevant part of the model.

Furthermore, reviewing designs digitally improves engagement as the 3D information is much easier to understand. This can in turn lead to improvements in the design, such as factoring in operation and maintenance needs at an earlier stage. The review process also becomes a lot faster — 3D models can be issued in advance of a review meeting, so amendments can be made in real time with the designers.

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INVESTMENTS SUITED TO LARGER SCHEMES

In larger schemes the challenges are different. The investment case is often easier as costs can be justified within a single project. However, changing established ways of working both for water companies and the supply chain can be considered an expensive risk, so appropriate business cases need to be formed. Below, we illustrate five technologies worth considering.

Design for manufacture and assembly (DfMA)

DfMA is an approach to design that improves the accuracy and efficiency of manufacture and assembly, as structures built digitally are then replicated in the real world. By using a 3D model in design, we can be confident that offsite manufacturing of parts will be accurate, ensuring a perfect fit during construction.

This has many advantages. Manufacturing offsite reduces health and safety risks, as parts are built in a more controlled environment. In addition, parts can be manufactured months in advance, and delivered to site when and where they are needed. This limits waste and time spent onsite, ultimately reducing the construction programme.

Throughout the next regulatory period, we expect modular construction to become the norm for repetitive work.

Data collection

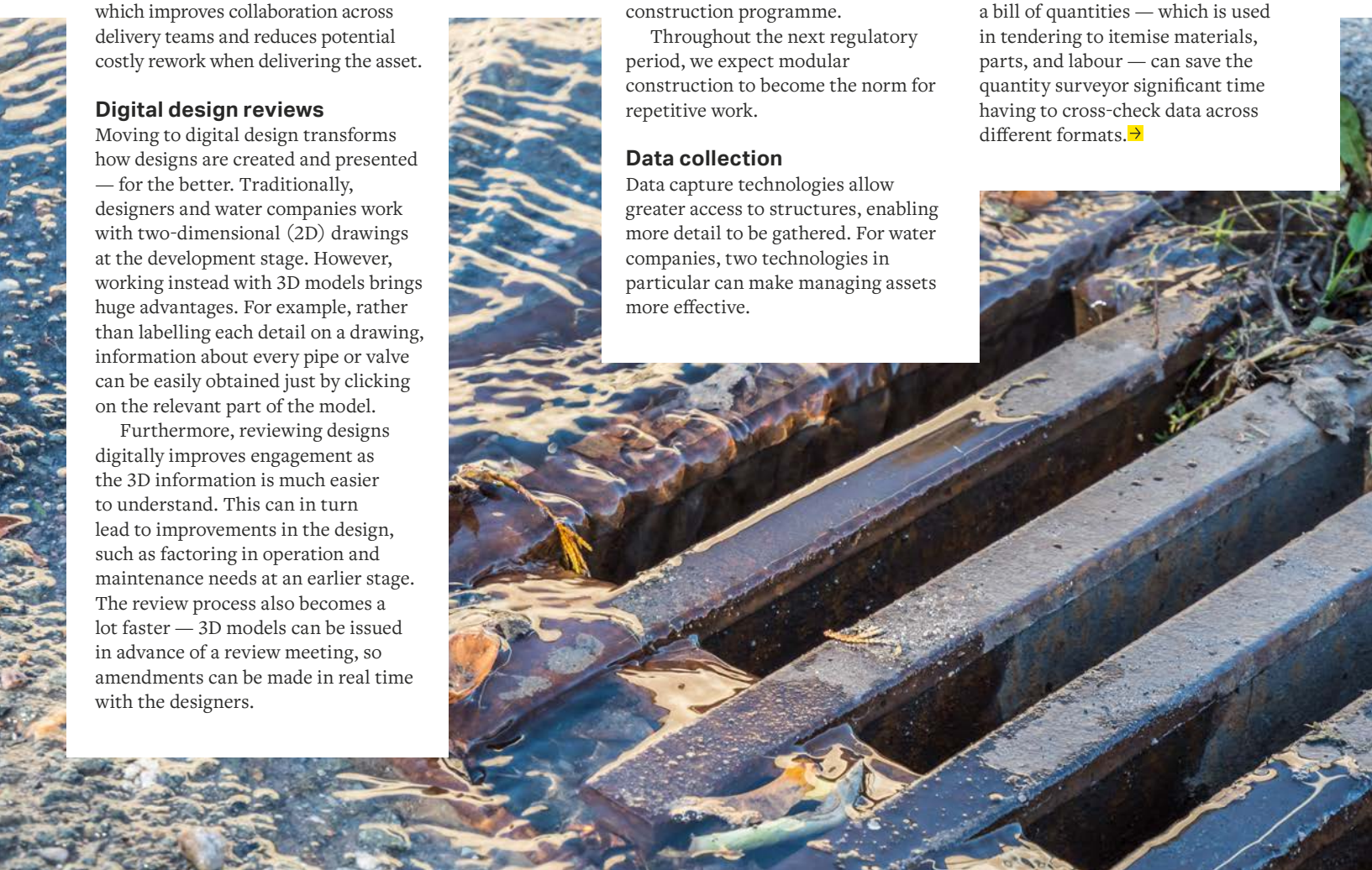
Data capture technologies allow greater access to structures, enabling more detail to be gathered. For water companies, two technologies in particular can make managing assets more effective.

Laser scanning captures information about an object in a digital format and stores it over the internet in the cloud. This is a quick way to scan all assets in a structure and create a 3D model that can immediately be viewed and analysed on screen. Using the cloud to store large data files, as opposed to storing them locally on a computer, means water companies can work with and share data more easily.

When it comes to larger structures, building surveys can be done with drones. Thanks to 5G technology, in the future images will be received in real time from remote locations so the drone can be directed either to get more detail or to take a second look where necessary. In addition, drone surveys remove the need for access scaffolding, saving time, cost and reducing safety risks.

Data-rich 3D models

A step up from the 3D models mentioned earlier is the data-rich 3D model, which allows the user to structure data consistently across a programme of works or across the entire business. This makes it much easier for water companies to know what assets they have and where they are. For example, gathering information digitally for a bill of quantities — which is used in tendering to itemise materials, parts, and labour — can save the quantity surveyor significant time having to cross-check data across different formats.



All objects have a lifelong unique classification code that is used within and across projects. As mentioned in the standardisation section, the classification system is currently specific to a particular company.

However, if all companies were to employ the same system, there could be consistency across the industry, saving time when working on different water industry projects. We, as well as BIM4Water, recommend using the UniClass 2015 classification system, which covers all construction sectors.

Automated construction scheduler

A software tool created by AECOM, the automated construction scheduler uses a 3D model building process to help determine the optimal construction sequence for any construction project. It gives comprehensive information on how much time the build will take, what resources are needed, staffing requirements and even how long each task will take to complete. It will also advise the fastest way to build something with the resources at hand.

This kind of technology is possible because of the availability of a digitised data-rich 3D model coupled with classified and standardised parts.

Intelligent process and instrument diagrams

All designers work with 3D design models as well as 2D schematic process and instrument diagrams (P&ID) that provide an overview of a system including pipe runs, valves and any equipment. Intelligent P&ID's link the 2D schematic and 3D model digitally via a classification system that tags each piece of equipment, ensuring both models reflect each other accurately.

This intelligent link ensures that all valves and equipment shown on the P&IDs are accounted for in the design outputs for construction, helping ensure both process safety as well as access, lifting and maintenance considerations are fully accounted for.

DIGITAL DELIVERY ACROSS A PROGRAMME OF WORKS

When used across a programme of works, digital delivery provides a range of benefits, from continuous learning to time and cost savings. It also enables independence. Once the technology is mastered, decisions can be made and assets managed using the digital platform. Below we look at two digital technologies that have the potential to bring about significant change for the industry.

Digital twin

A digital twin is the digital representation of physical assets and networks. Sensors installed on various parts of a physical network feed data to a digital twin, which then analyses the information to assess how the network is performing and if there are any problems. The software continuously learns and updates itself from multiple sources to give real time information.

To support the uptake of digital technologies in the UK construction sector, the government established the Centre for Digital Built Britain Britain in partnership with Cambridge University in 2017. Its national digital twin programme is intended to help the rail, road, power and water industries increase productivity by gathering data from digital twins.

Modular design

Integrating modular design across a programme of works has obvious time and cost savings, both through the design and construction process.

At AECOM, we hold designs for parts in a cloud-based, digital design library. Generic parts, such as valves and pipe fittings can be used for different water companies on different projects, as they are standardised. This saves time and money as we are not repeating work for each new project. When a water company has a programme of similar schemes, designs can be replicated.

Working with a modular design means that water companies can also save money by buying in bulk from suppliers for future and ongoing projects. Identical spare parts that can be used across multiple sites can be stored and accessed in the event of a problem on-site, reducing outage time and simplifying operation and maintenance tasks.

The time is right

The cost and time-saving benefits of digital technologies outlined above make the investment case clear, whatever the scale. However, these benefits need to be accompanied by a cultural change across a company and its supply chain, driven from the top, to ensure confidence in moving away from traditional approaches.

As we enter the next regulatory period, companies who haven't set up a common data environment or standardised processes should consider doing so, as well as incorporating digital design reviews as part of their standard operating practices. It's easy to layer on further digital solutions for larger scale projects as and when the need arises.

In addition, going digital makes managing assets easier, both in terms of understanding and monitoring them. This reduces the risk of outages and failure of plants, producing improved results for this regulatory period and beyond.

> "AECOM IS HELPING TO SHAPE OUR FUTURE APPROACH TO DIGITAL TECHNOLOGY. WE ARE SEEING A NUMBER OF BENEFITS SUCH AS IMPROVED ENGAGEMENT AND 'BUY IN' FROM OPERATIONS, AND SIGNIFICANT TIME AND COST SAVINGS.
>
> — SIMON OSBORNE, DELIVERY MANAGER, WESSEX WATER

CASE STUDY:

DURLEIGH WATER TREATMENT CENTRE, SOMERSET, UK

AECOM is the design partner for Wessex Water's £40 million flagship project to reconstruct Durleigh Water Treatment Centre in Bridgwater, Somerset.

This technically complex project is Wessex Water's first scheme delivered to BIM Level 2, where building information is developed in a collaborative 3D environment. With support from AECOM's UK and international cross-sector BIM team, a range of digital engineering innovations were identified and introduced to this large scheme, as well as to the wider Wessex Water business. These included:

- **Digital collaboration platform:** AECOM hosted a Common Data Environment (CDE) for the project using Bentley Projectwise collaboration software. With consistent project information, stored, controlled and audited centrally there was a single, reliable source of truth so duplication, repetition or rework are avoided. The client, designer, contractor and wider supply chain all have CDE access enabling collaboration.
- **3D engineering and visualisation:** AECOM delivered Wessex Water's first BIM Level 2 model. The model contains data outputs from ground penetrating radar, drone surveys and laser scans to ensure existing equipment is accurately modelled. This is vital given the need to design new equipment to fit and interface with existing plant. The model fully integrates the civil, MEICA and process design.
- **The igloo:** The 3D model was combined with gaming technology to create a virtual reality model. This virtual world is hosted in 'an igloo', a fully immersive cylinder with 360-degree model projection. The igloo enables teams of up to 12 people to stand within, and walk around, a virtual model of a project. Design reviews can be carried out from within the igloo aiding design coordination, stakeholder buy-in and plant operability review. Health & Safety issues in construction and operation are more easily identified and eliminated.
- **Virtual construction sequencing:** A 4D time-based construction sequence has been created by linking the model to a Primavera construction programme. It is being used by the contractor to review buildability, site resourcing, sequencing to reduce safety risks and work area planning. This is allowing the creation of an optimum construction sequence within the tight physical constraints imposed by the impounding reservoir dam and access road.

The digital approach brings many benefits:

- **Efficient and effective design reviews:** The 3D visualisation allows the delivery team to quickly understand how the proposed works will look and function, leading to sound and timely decision making. Design reviews take less time with an estimated £200,000 saving for the project.

- **Clash elimination:** Over 100 design clashes were automatically detected. Resolving these early reduced construction risk and led to a simpler underground pipework design in a constricted area of site, offering programme savings estimated at one week.
- **Value engineering:** Our model visualisation identified value engineering opportunities including rationalisation of the wastewater area with a potential £200,000 saving.
- **Drone surveys eliminate safety hazards:** Drones were used to undertake a structural survey of the existing chemical building roof, creating a permanent high definition record of roof condition for future reference. The use of drones eliminated the fall-from-height hazard associated with access to, and work on, a fragile roof. WL