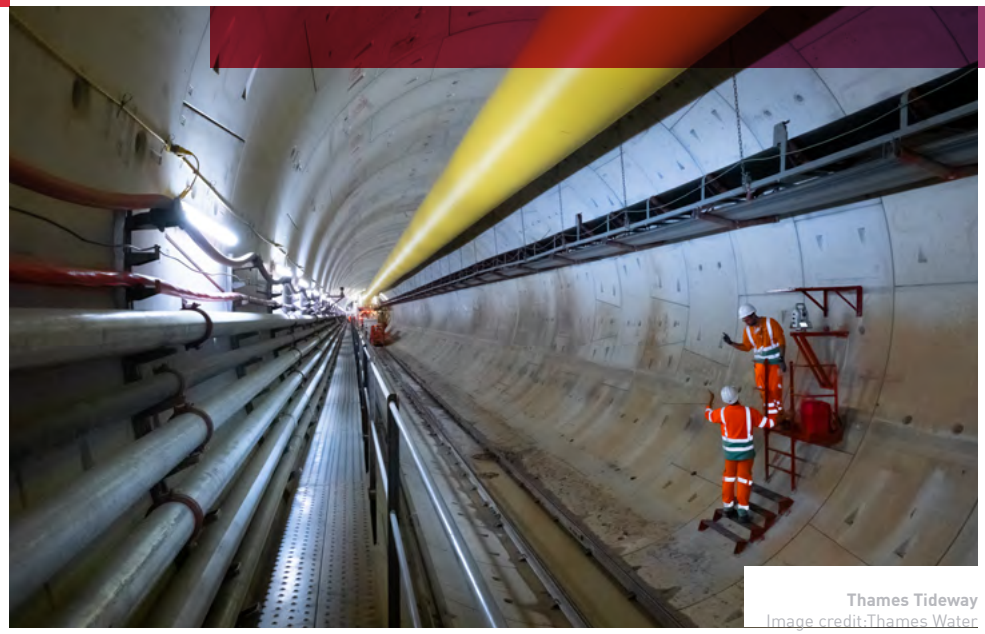
UtilityWeek™

In association with Ordnance Survey

INSIGHT REPORT

Identify inefficiencies today – transform project delivery tomorrow

In this report



Thames Tideway
Image credit:Thames Water

The challenge of replacing much of the aging infrastructure underpinning the UK's energy and water networks will require utilities to find new ways of working, with a requirement to build for the future but ensure efficiencies in the present. This report examines how companies are exploring new approaches to improve the efficiency of infrastructure projects and how location data can be the "glue" that holds major projects together.

Introduction

Much of the infrastructure that forms the backbone of the UK water industry is over 100 years old, such as the London sewerage system.

While other elements are obviously newer, the most recent round of major water infrastructure projects in the UK was finalised in the 1980s - when the last storage reservoir was completed.

In the subsequent 40 years, the water situation in the UK has drastically changed due to a combination of factors including population growth and climate change, resulting in an excess of water in some parts of the country and a severe shortage in others.

These problems can only be solved by investing in new infrastructure, with the Environmental Audit Committee calling for the regulator Ofwat to prioritise long-term investment in wastewater assets earlier this year.

This means water companies are facing undertaking new physical infrastructure projects for the first time in a generation.

As the National Infrastructure Commission estimates that new water supplies equivalent to the water consumed by over nine million people will be needed by the mid 2030's, time is not on their side, while the regulator is pushing hard for water companies to deliver under budget.

Helpfully water companies will be able to take advantage of a lot of innovation that has occurred in project delivery over the last 40 years to complete these new projects on time and on budget, including new ways of working, new training methods and collaboration across the sector.

Some companies are also taking the opportunity to experiment with utilising digital twins to determine the benefits to project delivery, which will also be able to help feed back into maintenance projects in the future, winning further efficiencies.

To explore the potential for new approaches to improve the efficiency of infrastructure projects in the utilities industry Utility Week has partnered with Ordnance Survey for this report

Many thanks to the varied commentators who gave their time and insights to help form the content of this report.

The challenge of delivering infrastructure projects

All three of the utility sectors – water, gas and electricity – are facing unprecedented change.

For the water sector these challenges can only be solved by investing in new infrastructure.

Meanwhile, as the solution to the problem of heat remains unclear in the UK, the payback period allowed for investment in the gas transmission and distribution system is being limited by the regulator Ofgem while a question mark hangs over the future of the gas grid.

Gas distributor SGN has recently completed a £250 million infrastructure project to connect eight towns in Northern Ireland to the gas grid for the first time by laying 200km of new pipeline, but in its 2020 annual report the company said it is "highly likely" it is the last large-scale new transmission pipeline project for the conveyance of natural gas in the UK.

The Water Resources National Framework is clear that urgent action must be taken to ensure many areas of England don't face water shortages by 2050.

This includes reducing demand, but also developing new supplies such as reservoirs and desalination plants, and new schemes to move water to where it is most needed.

New pipeline commencement at Tower Lane, Harmston. Image credit: Anglian Water

In 2019 regulators Ofwat, Environment Agency and Drinking Water Inspectorate joined forces to form the Regulators' Alliance for Progressing Infrastructure Development (RAPID).

RAPID aims to accelerate the development of new water infrastructure projects, with £469 million ringfenced in the regulatory cycle PR19 to make projects shovel-ready from 2025.

These include several new reservoir projects and water transfer schemes.

The water companies involved will be looking to Portsmouth Water to learn lessons on how best to approach these projects as it has already embarked on constructing the first water storage reservoir to be built in the UK since the 1980s.

Similarly Anglian Water has already begun a project to build 500km of new pipeline - one of the largest strategic water infrastructure projects the UK has ever seen and has seized the opportunity to test new ways of managing infrastructure projects to create project efficiencies.

The Thames Tideway project – the largest infrastructure project ever undertaken by the UK water industry has also tested out the use of Building Information Modelling and a digital first approach to overcome many of the common challenges of infrastructure projects on this scale.

The main pain points of infrastructure projects at this scale are sourcing reliable data on which to build the project and collaborating with the

numerous parties involved in the process such as contractors.

All construction and infrastructure projects are by their very nature place-based challenges, with the locational context and environment often determining whether a project can be seen through to completion in the optimum time.

Simon Navin, geospatial lead at global solutions provider Jacobs, describes location data as "a glue" which holds a project together.

"When designing, developing or managing infrastructure, it is essential that we know accurately where existing assets are in the ground, where they can be avoided, what the context might be in relation to the geology, what the context might be in relation to local habitats or local settlements," he says.

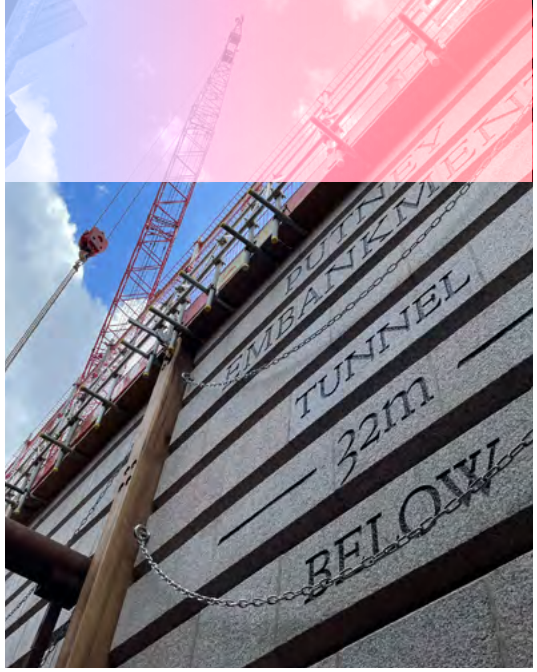
However, obtaining accurate location data about a site and any other assets that may be in the vicinity is one of the biggest friction points in project delivery.

This is certainly true for Portsmouth Water's Havant Thicket reservoir. Three years of the ten-year project were spent establishing accurate data about the location and environment to inform the design and planning process.

This included monitoring underground water and conducting geophysical surveys.

Although Portsmouth Water undertook the surveying itself, often the necessary data is already held by another party, which creates its own problems as utility companies must then establish the accuracy of the shared data.

Inaccurate data may be due to a variety of reasons such as a large percentage of underground assets which were installed before data standards were implemented, companies inheriting legacy data with little ability to check facts, and changes to the physical environment which makes existing depth information redundant.



Thames Tideway
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Each utility company holds its own data, so sourcing from numerous parties, and dealing with inconsistencies between how data is collected and recorded by those different parties takes up a huge amount of time at the start of a project.

"Often, the challenge isn't about if asset records exist, but if those records have been shared with all of the relevant stakeholders.

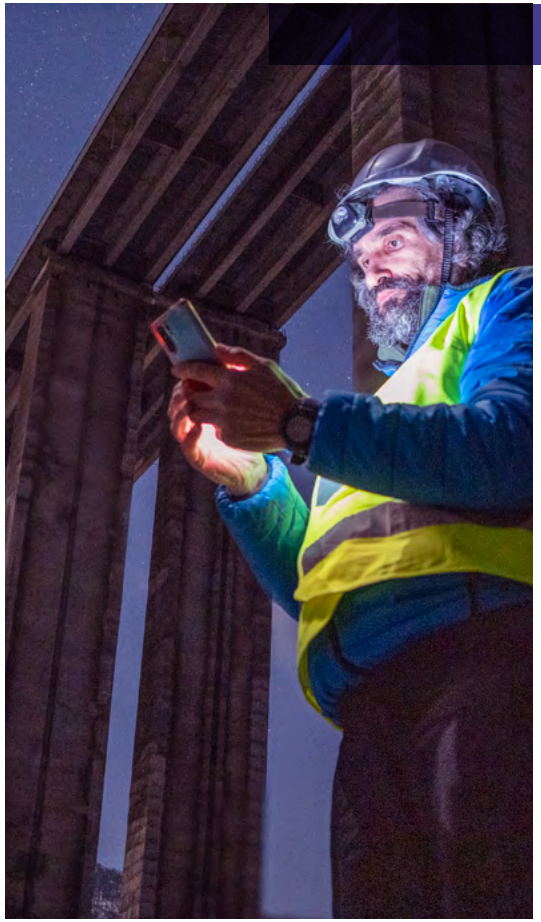
"Asset records need to be put into an environment where they can be shared safely, securely and with the right levels of privacy and ethical considerations around the use of location data, along with an understanding of the efficacy and quality of that data" says Navin.

Analysis commissioned by the Geospatial Commission in 2018, which was established to set the UK's geospatial strategy, revealed that more accessible and better-quality location data in infrastructure and construction could be worth over £4 billion a year.

One of the Geospatial Commission's solutions is to create a national digital map of all the UK's 1.5 million kilometres of underground utility assets which all involved parties can access before starting any works.

Geoscience technical adviser at the Geospatial Commission, Holger Kessler agrees with Navin that the level of digitalisation in the utilities industry is not the problem, it is the fact that that data is not currently shared.

He says that water companies are leading the drive for better interoperability of data between companies, which is understandable given they must navigate all other utility assets in order to access their own.



How new approaches are bringing project efficiencies

Despite engineering and construction ranking second only to agriculture for its adoption of digital techniques, engineers within the water sector are keen to embrace new ways of working.

Wessex Water, which is the only water company in the UK which acts as an owner, operator, designer and contractor made investing in technology to improve and enhance their ways of working one of its key priorities for the current regulatory cycle.

It has already reaped the benefits of utilising technology to the Building Information Modelling (BIM) level two standard, which realised savings of £300,000 on a £50 million water treatment reconstruction project.

Although BIM was already being used within the company, the recent pandemic has helped push it closer to being business as usual practice, says Wessex Water's strategic digital manager Adam Bear.

The use of BIM 360 allowed the company to continue to meet the fast paced demanded by the Asset Management Plan (AMP) period while also allowing remote working with an entirely digital approach.

> "We are developing standard products and factory environments. We can build a temporary structure in a field as our factory environment and build sections of valving within that."
>
> Guy Gregory, SPA digital twin and data officer, **Anglian Water**

BIM 360 is a single connected cloud-based platform that brings data together in a common data environment, allowing all involved parties to access and update 'live' documents.

Earlier collaboration between different supply chain partners is one of the key benefits of the approach, says Bear, as the enhanced ability to share and track work packages helps establish a single version of data truth.

Improved certainty of design leads to fewer changes and reduced time on site, he adds.

Other benefits include optimised sequencing, early clash detection and the opportunity for standardised products.

Developing standard products and shifting to a production-based approach rather than a traditional construction one has been a major benefit of a new digital approach on its Strategic Pipeline Alliance (SPA).

"We are developing standard products and factory environments. We can build a temporary structure in a field as our factory environment and build sections of valving within that.

"It's a sterile environment and we are already seeing huge benefits in productivity and cleanliness; a clean environment helps us get it right first time while meeting water hygiene standards," says Guy Gregory, SPA digital twin and data officer at Anglian Water.

The new digital approach has also enabled new pipeline installation techniques to be optimised and cut the time from days to just hours needed to adapt decisions when things go wrong.

Anglian has been able to take this approach due to the development of a digital twin of the project which utilises a common data environment and

enables improved collaboration with Anglian Water's supply chain partners by enabling a completely different way of working.

Contractors can access a Geographic Information System, a content store for documentation and a model store for drawings and models online.

"We allow the supply chain entry to all of those models to collaborate, if there is a change everyone sees it at the same time, everything is done via direct entry into the common data environment," says Gregory.

Anglian Water is using the SPA project as an opportunity to establish the data foundation for comprehensive digital twin across its asset base.

"We need to raise our entire asset base up to an appropriate level so that we can have this comprehensive digital twin of our entire estate, SPA will help us by being a trailblazer for the standards and governance that needs to achieve that digital twin," says Tom Burgoyne, enterprise data architect, Anglian Water.

> The industry is committed to creating shared data environments so better decisions can be made, but recognises that this is not without its sensitivities and challenges."
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Thames Tideway
Image credit: Thames Water

Bear adds that there is excitement around "breaking down the silos" within these engineering projects by everybody being on the same platform and able to access the same data.

"The industry is committed to creating shared data environments so better decisions can be made, but recognises that this is not without its sensitivities and challenges," says Navin.

Moving to a fully digital, collaborative approach by establishing common data environments at the start of a project helps to build trust in the data being shared.

Navin says that these common data environments are essential to all infrastructure projects as collaborators must trust and understand the quality of the data they are making risk-based decisions upon.

There is also a question around liability with sharing data, which the Geospatial Commissions' National Underground Asset Register (NUAR) plans to address through the creation of a legal framework for the sharing of asset data.

The benefits of being able to overcome these data sharing barriers are clearly shown by the efficiencies gained on the Thames Tideway project.

The £3.8 billion tunnel will prevent wastewater flowing into the river Thames when it rains, aiding one of the greatest environmental clean-ups in history.

The use of a fully integrated BIM model prevented the need to produce physical drawings until the detailed design stage, and the use of a common data environment enabled a level of collaboration not previously possible between the 12 different design disciplines and numerous participating firms spread across Europe.

The main challenges facing engineering firm Mott MacDonald included reducing the number of deliverables on the project, controlling the vast amount of data, standardising processes, reducing rework, and streamlining the review process.

Virtual reality linked to the BIM model was used to ensure the design met safety requirements and identify critical issues with the design, improving the efficiency and accuracy of the analysis.

Overall, the use of such technology cut the design element of the project by six months.

Why digital twins could be used for scenario planning in the future

Water companies are already exploring the creation of digital twins to bring about huge efficiencies in project delivery by digitalising the design and scoping stages.

But the benefits of developing on geospatial digital twins could be huge, says Neil Walker, director, asset management systems at project management consultancy Atkins.

These benefits would go beyond just improving project efficiency for big capital investment projects and would allow utilities to optimise the design and operation of their systems.

Work carried out by Atkins on a wastewater twin identified around 40 benefit areas on just one asset, one of which is the ability to carry out scenario planning and system optimisation – a vital capability as the water industry transitions towards net zero.

At the same time as developing the foundations for a digital twin, Anglian Water is also working on a potential use case.

The Climate Resilience Demonstrator (CReDo) project is a climate change adaption digital twin which is designed to improve resilience across infrastructure networks.

The joint project between asset owners Anglian Water, UK Power Networks, BT, the Connected Places Catapult and numerous academic partners is part of efforts to create a national digital twin.

The aim of the project was to model both the interconnectivity of different asset bases and how flooding would affect them to produce a decision support tool to help the company's strategic planners.

"We haven't modelled if that substation that we rely on is in a flood plain; we've modelled whether our own assets are in the floodplain, and while we have an implicit understanding of the fact that we are connected to that substation, we don't have that full picture," says Burgoyne.

"The tool will allow us to make better decisions by getting that information earlier in the process with less friction."

"If that open data element of the national digital twin continues to grow and be more valuable, then there will be less friction in getting sight of other owners' infrastructure so we will be able to make more effective decisions earlier and quicker."

This move forward from a simple geospatial digital twin to more sophisticated models is happening

right across the water sector as companies start to leverage their operational data to meet the challenges facing the industry.

"There are so many opportunities for what we define as data twin and digital twins; we are seeing a lot of water companies going after wastewater treatment plants because of net zero challenges, net zero is a big visionary objective for the water industry," says Walker.

"A lot of people say they have twins, and they have visual representation of the built environment, but the higher maturity twins are benefiting from scenario modelling planning and rehearsal."

"The water industry is going to take at least 5-10 years to get to the level of confidence and trust in twins needed so that once we get the scenario and rehearsal cracked, then it can think about robotics," adds Walker.

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For the gas industry, increased data sharing on this scale between industries would allow it to pre-plan where it is likely to invest in its network in the future.

Gas distribution network operator Cadent is currently in the process of creating a heat map of its network ready to inform its network optimisation plans during the transition to low carbon heat.

The map, which is due to be at street-level granularity by the end of the year, will be used to help the company predict which low carbon technologies households are likely to transition to for their heating needs in a given area based on Energy Performance Certificate (EPC) data.

This could then be cross-referenced against their own network to understand the capacity for both hydrogen and electricity in particular areas, and where to focus investment.

Cadent net zero manager Philip Halsey believes that local factors such as whether there is a heat pump manufacturer in the area, or the capacity of heat pump installers could also affect uptake.

Halsey admits that the map will be based on a set of "brutal assumptions" to work out which of five scenarios it has planned are likely to come to fruition, but its current model will not be able to account for one important factor – customer choice.

He hopes that in the future AI could be used to map different scenarios on the map, such as customer choice, social and demographic factors or the introduction of a financial incentive scheme.

Increased collaboration achieved through more open data is the foundation for achieving project efficiencies in the major capital investment projects of today.

But the work being undertaken now by utility companies will also open the door to further efficiencies in strategic planning and operation of their systems in the future.

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Chris Tagg
Head of OS Connect
Ordnance Survey

It's encouraging to see here that utility companies are harnessing the benefits of using geospatial technology more and more. Understanding the location of major new infrastructure, running tests and simulations before they break ground and start the build are important steps to mitigate risk and to avoid construction related constraints that organisations perhaps wouldn't know about during the concept and design stages.

However, we have noticed a distinct shift in the sector. Utility organisations, suppliers of water or gas for example, are interested in sensing their network of services. They want to introduce sensors and telemetry into their key assets and monitor how the network is behaving in near real-time. They also need to know the age of the network, when it was built, material composition, and dimensions of the network.

This additional data can be used in project planning, operations as well as implementation. By adding geospatial data, a valuable reference framework can be provided to organise a variety of data feeds based on the location of the objects where new data is collected or sensed.

There are many good examples in which maps and digital visualisations have been successfully used to integrate data, manage projects and mitigate risks. Making data interoperable and unifying separate datasets into a single version of the truth typically requires efforts beyond the scope of an individual project. In the medium and long term an interoperable data framework can improve the decision-making process, and potentially avoid unplanned risk or expenditure further down the line.

"Harnessing geospatial datasets enables the development of 'Digital Twins.' Digital Twins are more than "just a map," they require utmost accuracy, and near real-time updates, to be used for simulations, and testing the behaviour of any proposed changes or developments."

Harnessing geospatial datasets enables the development of 'Digital Twins.' Digital Twins are more than "just a map," they require utmost accuracy, and near real-time updates, to be used for simulations, and testing the behaviour of any proposed changes or developments. It provides a means of testing the network, running simulations to test scenarios, before any physical work even begins. (And, potentially, causes an issue.)

Water and energy can adopt this concept. Organisations can design and test proposals; carry out scenario planning for a new infrastructure asset such as new sewage or water systems. The Digital Twin can also help users to understand the possible impact(s) on customers and the wider geography, such as spilling sewage into a river or lake.

A single, unified, and digital version of the truth helps understand operational impact and mitigate risk in relation to regulatory lines. For example, should an incident occur, the utility will need to investigate what happened and show evidence to the regulators they have done everything possible to avoid that outcome. A digital twin scenario may help to prevent some of these incidents, before any work (or incidents) even occurs.

And the only way to build such an effective and efficient system is with access to accurate, geospatial data.

Ordnance Survey provides national mapping services for Great Britain and is a world-leading geospatial organisation.

We empower businesses with data insight that drives efficiency and progress in a fast-moving world.

Our location data solutions and services provide a complete view of infrastructure assets above and below ground.

Our commitment to geospatial innovation helps energy, water and telecom network operators in Great Britain see a better place.

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