

BIM4Water case study template		
Section 1: Project Details		
Project name	Strategic Pipeline Alliance (SPA) Pipeline and Digital Twin – SPA Digital development Case Study SPA Control Strategy (SPA3)	
Client	Anglian Water Services Ltd (AWS)	
Project Scope and Outcomes	<p>The Anglian region is one of the driest regions in the country receiving on average only two thirds of the national average rainfall. In addition to water stress the region’s population has grown by 20% in the last twenty years and is expected to grow further. There is also a need to protect the environment from over-abstraction and hence the 2025 vision is to deliver a large-scale, holistically linked water transfer resilience system. It will be operated, performance managed and maintained using advanced digital technology.</p> <p>SPA will deliver elements of the AWS Water Resource Management Plan (WRMP) to make the East of England Resilient to the risks of drought and reduce customers on single supply system to 14.1% by 2025. The SPA project consists of up to 420km of pipeline, pumping stations, storage points and a Digital Twin.</p> <p>SPA has been set up as a highly integrated shareholder Alliance where reward is based on outperformance and the delivery of the customer outcomes.</p> <p>SPA will deliver a physical asset consisting of the pipeline, various pumping stations, and storage tanks. SPA will also leverage value from digital to both create the physical asset as well as a Digital Twin for Anglian Water that will assist with asset management by collating data to analyse and use for simulations and decision making.</p> <p>The programme will deliver the physical and digital outputs using Production thinking and will use Project 13 methodologies. Project 13 is an industry led initiative with a model based on enterprise, not on transactional arrangements, to boost certainty and productivity in delivery and improve whole life outcomes in operation. SPA will act as the ‘Integrator’ in the Project 13 initiative.</p> <p>All monopoly water-only and water and wastewater companies in England and Wales are required to deliver to the levels of service (Outcomes) that their customers expect of them. There are rewards for outperforming these measures which are monitored by the water Regulator Ofwat.</p> <p>This is the third in a number of case studies that will track the progress of the SPA programme, taking ‘snapshots’ at appropriate milestones. This Case Study is the ‘SPA Control Strategy’.</p>	
What are the project timescales?	Brief and Team Engagement	March 2020
	Design	July 2020 – October 2022 (pipeline), Forecast August 2023 (Non-Infrastructure)

	Construction	July 2021 – Forecast March 2025
	Commissioning and handover	Forecast December 2022 – March 2025
What is the total project budget (including fees)?	£325m (£285m post efficiencies) – NEC ECC (New Engineering Contract) (Engineering and Construction Contract) Option C	
Type of work (new build, refurbishment, Repair & Maintenance)	<p>Physical assets - new pipelines, pumping stations, storage points, control, communication, and sensors.</p> <p>Digital assets – Data collation, integration, analytics, and decision making (as part of a Digital Twin).</p>	
Asset type	Water supply	
Section 2: Stakeholders		
Who is involved in the project team? (<i>Where known</i>)	Delivery partner(s)	Strategic Pipeline Alliance - Anglian Water, Costain, Jacobs, Mott McDonald Bentley, Farrans
Indicate (F) if they were appointed via a framework.	Key supply chain partners	Atkins
	Other key parties	Barhale Ltd, Volker Trenchless Solutions, Socotec UK Ltd, Dunelm Geotechnical and Environmental Ltd,
Lead contact details	Name and designation	Guy Gregory, SPA Digital Twin and Data Officer
	Organisation	Anglian Water
	E-mail	ggregory@anglianwater.co.uk
	Telephone - Landline	07736 175696
	Case study written	April 2023
Section 3: BIM (Better Information Management) details		

Background - how long has the Client been using BIM and what is the overall progress to date?

Can you provide an overview of the Technology arrangements to support BIM?

There is a general understanding of the benefits of compliance with ISO 19650 (PAS 1192) in Anglian Water, but the use of BIM has never been formally mandated for a capital project.

SPA recognises that BIM principles will drive outperformance, and initial focus was to ensure that the foundations were in place to enable us to maximise benefits from data and information.

To smooth the integration of our physical assets and the associated data and information produced as part of the delivery our enterprise architecture focussed on delivering a solution that would:

- Maximise the benefits from the existing Anglian enterprise.
- Ensure that data and information would integrate seamlessly with existing Anglian repositories.
- Be easily transitioned at integration stage.

This approach would not hinder bringing any additional systems that would benefit Anglian Water but would ensure that any legacy systems were planned for seamless integration giving a longer-term benefit (blueprint) for other and future Alliances.

Anglian Water has a coherent strategic intent to move towards an Industry 4.0 architecture, which includes the new Operational Technology (OT) Strategy as a subset of this (see diagrams at the end of this case study).

The Anglian Water OT strategy is a highly important aspect of the digital twin landscape as it helps describe how these control systems should be implemented and used. It focuses on the use of control and automation technologies to optimize the performance of operational systems. The OT strategy is implemented by using various control and automation technologies, such as Industrial Internet of Things (IIoT) enabled SCADA systems linking into an Industry 4.0 approach with a central data core. This approach takes the principles of Edge Driven (to ensure that the most up to date information can be used), Report by Exception (to minimise data transfer) and Open Architecture (to avoid vendor lock in). A further principle of Connect, Collect and Store, means that all data is enabled within a connection (to enable ease of future enhancements), what is needed to be looked at is physically collected and looked at, and only what is needed from a latest data update, trend analysis, or historical perspective is stored on a long-term basis.

What is the BIM scope for this project and is it planned to use key documents, e.g., EIR/BEP plan/AIR etc.

At an early stage in the project mobilisation phase there was a conscious decision to use BIM principles.

Development of the BIM strategy identified the need for the following BIM tools in line with recommendations in ISO 19650 (PAS1192-2):

- BIM Execution plan – in response to the Exchange Information Requirements (EIR).
- Common Data Environment (CDE) – to allow exchange of information within the project team and the wider supply chain eco-system - Geospatial Information Systems (GIS), BIM360, Azure, SharePoint.
- Master Information Delivery Plan (MIDP) – to manage delivery of information during a project.
- Supply chain EIR.
- Asset Information Model.
- Naming convention.

The SPA programme of work covers 21 individual projects, or sections, of pipeline. Some discreet sections are being delivered by the Anglian Water @one Alliance.

SPA recognised that a key component in managing large infrastructure systems is the use of a "data core". A data core is a centralized repository for storing, processing, and analysing data from the pipeline and other systems. This data can include things like sensor data, control system data, and other operational data, as well as more IT centric data such as asset information, location data, hydraulic models, and BIM model data.

By storing this data in a centralized location, Anglian Water can easily access and analyse it to identify any issues that need to be addressed. Our Data Core solution involves the use of a centralized data storage and processing system, which is integrated with the SCADA system and other technology systems to provide a holistic view of the pipeline and its surrounding infrastructure. This structure links the structured and unstructured data in a way that is machine readable (using metadata tagging for unstructured information) and hence can be surfaced wherever it is needed from a single source.

This is a key difference between our approach and many other Proof of Concept activities within the market, as it is inherently scalable and able to more easily be productionised.

The implementation of the data core solution also provides opportunities for the development of a "Near Real Time Model" (NRTM) solution for SPA. An NRTM solution will allow Anglian Water to see how the pipeline is behaving in real-time and adjust as needed. By having this level of control, Anglian Water can ensure that the pipeline is operating at peak efficiency and minimize the risk of downtime or other issues.

<p>At what stage was the decision taken to use BIM on this project and has BIM been used throughout the project lifecycle?</p>	<p>The decision was taken to use the principles of BIM during the project mobilisation phase. It was understood by all Alliance partners that adopting BIM principles would drive efficiencies through the project lifecycle as well as the asset lifecycle.</p> <p>As an early adopter on the Project13 programme (Centre for Digital Built Britain) the relational development of our supply chain ecosystem was essential.</p> <p>One common difficulty that is experienced when using a single source of data is bridging the gap between the Information Technology (IT) and Operational Technology (OT) worlds.</p> <p>With the data core in SPA and Anglian Water, a strategy of synchronising data across the IT and OT boundary is to be utilised, ensuring that key information held within the IT environments (primarily Asset and Production Planning information) can be accessed in a safe and secure manner from the Operational Technology world, and behavioural information (sensor data and telemetry) can be appropriately accessed from the IT world.</p> <p>This enables models to be developed from the sensor data and events which occur on the site, or “edge” to drive activities such as maintenance which are realised from the IT environment.</p>
<p>How was the project team “brought on board” to use BIM?</p>	<p>The project team was brought together with a differentiated strategy. A core team is being put in place from an Anglian Water perspective which will drive corporate standards and ensure that key Anglian Water data sources are integrated. Project centric teams ensure that project specific information is integrated aligned to standards and governance, the development of which is in flight.</p> <p>As an interim measure SPA is taking the lead to ensure that there are a common set of principles and guidelines that all sites will adhere to and enable the governance to be guided in a pragmatic and appropriate manner.</p>

How did BIM impact on the design stage of the project? What were the benefits and to whom?

Control and automation technologies will be used within SPA to remotely monitor and control various aspects of industrial and infrastructure systems. From a control perspective to ensure the operation of what is a critical asset for supplying water to hundreds of thousands of customers, SPA has a three-layer approach to control.

Core layer

The core layer (Pipeline and Sites) is based upon autonomous control of each individual site, with a further "last line of defence" of manual site-based control. These are fully isolated from external influences; however, as the SPA pipeline is highly complex, this is not a sustainable position to be in for long.

SCADA

To automate and ensure that all of the 70+ sites that are linked to the SPA pipeline can operate effectively as a single system a SCADA (Supervisory Control and Data Acquisition) system acts as a Regional Control system over all the sites. This ensures that the right amount of wholesome water is received by the right customers at the right time primarily using a mass balance approach to ensuring that water is moved in a way that maximises supply against an agreed prioritisation.

Whilst this control system can ensure that the right amount of water is moved, it cannot optimise for cost, impacts related to the use of sustainable energy or other factors such as ensuring we optimise the amount of water we abstract, out of the ground over a yearly period. This is the job of a Near Real Time Model, which will look to optimise as much as possible these factors, making the SPA pipeline as efficient as possible.

NRTM

The NRTM solution is a "system of systems", as it integrates with multiple technology systems to provide a holistic view of the SPA pipeline and its surroundings. This integration allows Anglian Water to make informed decisions based on the data collected from multiple sources. The NRTM solution also allows for predictive maintenance, which is used to identify potential issues before they occur. Predictive maintenance will help Anglian Water to prevent downtime and minimize the need for costly repairs. In addition, the NRTM solution can also provide insights into the energy efficiency of the SPA pipeline, helping to reduce energy costs and improve the overall performance of the system.

The design of SCADA and NRTM components is predicated on having a single source of connected, openly available data that can be utilised by interconnected systems.

<p>How did BIM impact on the construction stage of the project? What were the benefits and to whom?</p>	<p>Most sections of the pipeline are being constructed in this phase of the project. Design of the non-infrastructure assets is well under way.</p> <p>The single data core is a co-development between SPA and Anglian Water, with SPA delivering some of the early thought leadership to turn a concept into reality.</p> <p>Capture of the design documents, elements of information relating to the build (including forms, images and videos), as well as the digitising of commissioning data is a key part of the process of building up a whole life view of the built environment.</p> <p>As the SPA pipeline is of a considerable length, the commissioning process will be completed within multiple phases.</p> <p>Utilisation of the design documentation to simulate the running of the pipeline and expected operational parameters will also be utilised within this extended commissioning process. It will monitor expected impacts of commissioning a segment of the pipeline on the wider system compared to expected impacts to help streamline and digitise this process.</p> <p>Utilisation of near real time data and a view only representation of the control (SCADA) system is imperative here to ensure that colleagues on site have access to data that is as up to date as possible, rather than having to resort to more manual steps to gain this data.</p>
<p>How did BIM impact on the operational stage of the project? What were the benefits and to whom?</p>	<p>The authors expect that the delivery of the Digital Twin will enhance the way that the infrastructure is operated. It is expected that the digital twin will enable sensors to collate data that will be analysed to create insight which will drive smart decisions, which will be acted upon autonomously.</p> <p>We are currently heading towards an operational environment but have not yet started implementation. It is anticipated that this question would be more fully answered in future case studies.</p> <p>One thing is clear that with the complexity of operation of the Strategic Pipeline and the necessity of structured Production planning to link together approximately 21 discrete water systems transferring water between them, without the SCADA and NRTM, ensuring that demand meets supply would not be possible if performed in a manual way.</p> <p>As such, this digitisation is a necessity for the success of the SPA programme.</p>

What were the estimated costs of utilising BIM on this project?

The cost of generating the enterprise architecture framework to undertake BIM was in the region of £66k.

From a SPA perspective, we are taking a Benefits Realisation Management approach. Benefits management goes to the heart of delivering projects successfully. If appropriate time is dedicated to benefits early enough, then clear objectives are shaped and there is an agreed understanding of stakeholder wants and needs.

Active and effective benefits management demonstrates the reason why a project should be undertaken, and as such should be managed as robustly as costs. The realisation of benefits show that a project has had a positive impact for stakeholders. Project success should be measured not only by the delivery of outputs to time, cost and quality but also the positive, measurable improvements they have delivered for stakeholders.

Benefits management is the "identification, definition, tracking, realisation and optimisation of benefits" and it follows the full extent project lifecycle (before the project, during the project and after the project).

While there are multiple definitions of a benefit, we will be using the UK Government Cabinet Office's definition namely - "the measurable improvement resulting from an outcome perceived as an advantage by one or more stakeholders, which contributes towards one or more organisational objectives."

This means that benefits:

- Should be measurable - if they cannot be measured, they cannot be claimed as realised.
- Are the improvement resulting from the outcome (the end result) of the change, they are not the change itself.
- Are in the eye of the beholder - in other words different stakeholders will value the same benefit differently.
- Create the link between tangible outputs (project deliverables) and strategic goals, and
- Ensure there is alignment of effort, resources and investment towards achieving organisational objectives.

Guide for Effective Benefits Management in Major Projects, (2017)

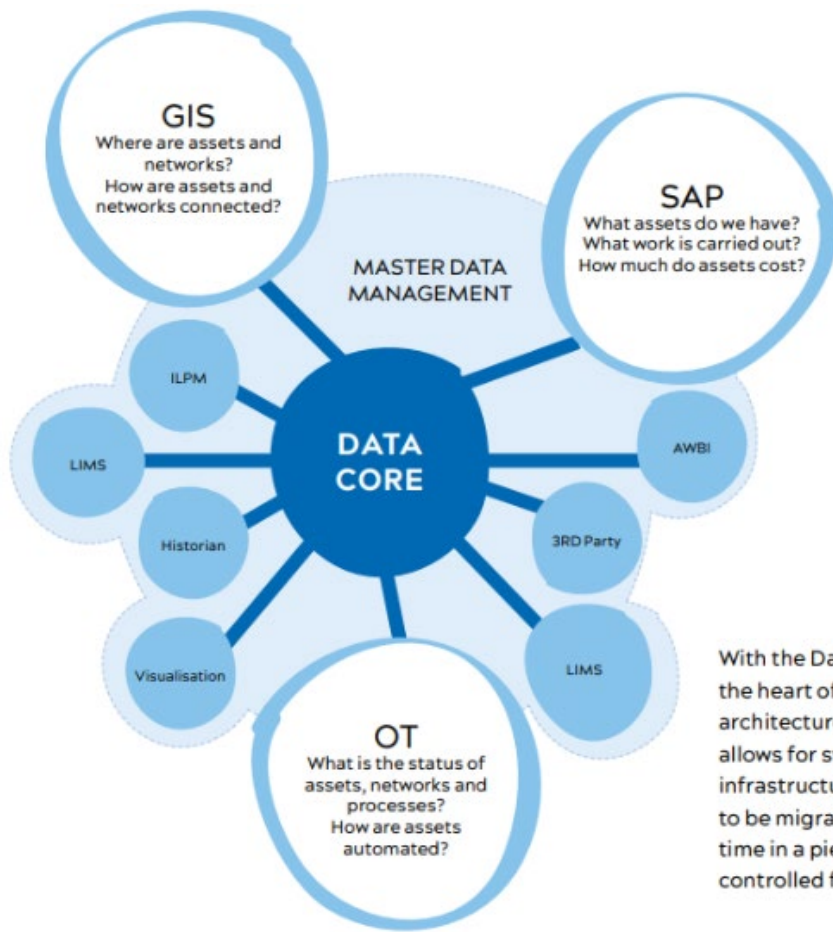
<p>What were the estimated savings from the use of BIM?</p>	<p>It is estimated that setting up our BIM framework will generate at least £1723k net savings over the project period, and we are now starting to realise this saving. A proportion of this is in the reduction in designer time, as well as project time saved. This is tracked.</p> <p>It should be noted that there are many non-financial benefits that have also been identified including benefits in safety (better identification of safety changes), to the wellbeing of our staff (reduced driving as collaboration in the model can be remote), and to the environment (reduced Carbon as less miles driven to meetings). There will also be Operational (Opex) savings because of the way that we collate, capture, manage and re-use data within the asset information model.</p> <p>There are also non-quantifiable benefits expected from a reduction in rework and prolongation.</p>
<p>Any other information</p>	<p>This is the third in a series of SPA Case Studies. It is intended to revisit this project at the end of the commissioning phase, and one year into the operation of the asset. The Case Study will be updated to reflect on further developments related to BIM and to determine whether planned benefits have been realised.</p> <p>The case studies will look at both the physical and the digital asset.</p>
<p>Section 4: Overall Assessment</p>	
<p>Was the use of BIM appropriate?</p>	<p>So far during the initial phase (it is now July 2023) we feel that we have made an appropriate use of BIM.</p>
<p>Are there clear benefits (both quantitative and qualitative) by applying BIM to this project?</p>	<p>We have clearly set out 'user stories' which have been assessed for both quantitative and qualitative benefits. Anglian Water collates the non-financial benefits (including measures against the Six Capitals) as these are important in how it achieves the ODI's.</p> <p>These user stories have led us to undertake numerous business cases which have demonstrated benefits for the implementation of BIM techniques and associated systems.</p>

<p>What are the key challenges in using BIM on this project and how were they overcome?</p>	<p>Industry 4.0 represents the fourth industrial revolution and represents a major shift in the way that industry operates. At its core, Industry 4.0 is about integrating digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), and machine learning (ML) into manufacturing and production processes to create a more efficient, flexible, and sustainable industry.</p> <p>The key principles of Industry 4.0 include: A common data core that connects people, processes, and technology; the use of data-driven decisions, continuous learning and skills development, and a focus on collaboration, change management, and cyber security; an inherent interconnectedness of all elements with sensing capabilities (both human and digital), to ensure all information is collected, connected, and stored to optimise outcomes.</p> <p>These principles aim to drive innovation and create new business opportunities when underpinned by clear strategic intent. Anglian Water is undergoing a Strategic Transformation Programme (wider than SPA) that is linked to key critical success factors across People, Process and Technology to enable this.</p> <p>People - critical aspect of Industry 4.0 is to ensure the workforce has the necessary skills to operate in an Industry 4.0 environment and are operating with the right culture to work together effectively to achieve business goals.</p> <p>Skills Development - Ensuring workforce has skills to implement and operate Industry 4.0 technologies is critical to success. This includes both technical and non-technical skills, such as data analysis and digital literacy.</p> <p>Collaborative Culture - Industry 4.0 relies on collaboration between departments and people. Promoting a collaborative culture across the organization is crucial to success. This is especially important for data management and governance.</p> <p>Continuous Learning - The technology and processes used in Industry 4.0 are constantly evolving. To stay ahead, it is important to ensure that the workforce is continually learning and updating their skills.</p> <p>Process - how things are done, is another key component of Industry 4.0. to ensure that the enterprise operates in the right ways to support an Industry 4.0 environment and embeds the level of agility and focus on data to drive the right outcomes.</p> <p>Change Management - Implementing Industry 4.0 solutions require significant changes to existing processes, systems, and organizational structures. Change management is critical to ensuring that these changes are smoothly implemented and adopted by stakeholders.</p>
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	<p>Data Driven Decisions - Industry 4.0 generates vast amounts of data. The effective use of this data to inform decision making is critical to success.</p>
	<p>Agile Process Design - Industry 4.0 requires a flexible and adaptive approach to process design. Adopting an agile approach to process design allows for quicker iterations and greater responsiveness to changing requirements.</p> <p>Technology - the backbone that enables an Industry 4.0 approach, ensuring that all data is collected, connected, and stored effectively and in a secure manner to enable decisions to be made in Near Real Time.</p> <p>Cyber Security - Industry 4.0 technologies generate and store large amounts of sensitive data. Ensuring that this data is protected from cyber-attacks is critical to success, especially where IT and OT convergence is considered.</p> <p>Interoperability - Interoperability ensures that different systems can communicate and exchange data with each other through common communication protocols. This does rely on provision of a reliable and secure connection between the various technologies used.</p> <p>Scalable Infrastructure - Industry 4.0 technologies generate vast amounts of data and require significant processing power. Ensuring that the infrastructure is scalable and able to accommodate this data and processing power is critical to success.</p>
<p>What could be learnt from using BIM on this project and applied elsewhere?</p>	<p>It is the intention that a blueprint will be generated that Anglian Water can extend to its other Alliances. We have already shared our Enterprise Architecture as well as other Applications with our other Anglian Water Alliances.</p>
<p>Has all appropriate changes or new asset data been transfer to Asset Management been completed?</p>	<p>Early trials with one small area of the pipeline for data transfer have shown that we have a journey ahead of us to guarantee success.</p> <p>Anglian Water is currently going through a transformation programme to ensure that the right people, processes and technology are in place to ensure the continued management of quality information.</p> <p>The initial implementation shows significant gaps in data ownership, automated data transfer into systems and cultural deficiencies in treating data as an asset.</p> <p>The Anglian Water Digital Strategy will remediate the technology elements that require upgrade, and a cultural and organisational change programme is ongoing to ensure that Anglian Water is ready to accept and maintain quality Asset Data created by SPA.</p>

<p>Client testimony (where possible)</p>	<p><i>SPA provided us with the opportunity to develop improved ways of controlling and optimising the new strategic pipeline. Updated and more flexible system architecture along with new tooling has helped drive us to look at how we operate, driving us to improve our business processes and associated decision making. The greenfield nature of the programme has overcome some of our traditional data challenges through improved network connectivity and unlocked data sources we've been unable to tap into in the past.</i></p> <p><i>Driving the value from these data sets is where both process change meets people change – essentially developing a new operating model to ensure effective running of the assets. However, this is just the start as the principles and practices being deployed to operate, optimise and maintain the pipeline are transferrable to other assets across Anglian Water.</i></p> <p><i>The digital twins developed will provide the opportunity to ensure we keep water flowing from our customers taps for generations to come, while at the same time allow us to optimise the pumping regimes to more effectively meet demand, saving both carbon and cost.</i></p> <p>Matt Walker – Strategic Programme Manager, Water Services, Anglian Water</p>
<p>What is the potential for rolling out any of the above benefits/lesson learnt etc across the water industry wide?</p>	<p>There is an opportunity to use the templates and blueprint that Anglian Water and the Strategic Pipeline are developing across the water industry.</p>
<p>Section 5: Case Study Administration Section</p>	
<p>Author and date completed</p>	<p>Guy Gregory (Anglian Water), Garie Warne (Costain), Leigh Taylor (Costain) - July 2023</p>
<p>Has a case study template been completed by this project before?</p>	<p>Yes</p> <ol style="list-style-type: none"> 1. SPA Initiation 2. SPA Design
<p>Glossary</p>	<p>Industry 4.0 – represents the fourth industrial revolution and represents a major shift in the way that industry operates. At its core, Industry 4.0 is about integrating digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), and machine learning (ML) into manufacturing and production processes to create a more efficient, flexible and sustainable industry.</p> <p>Edge Driven – bring computation and data storage closer to the source of data.</p> <p>Differentiated Strategy – an approach to provide customers with something different and distinct from others.</p>
<p>Version Control</p>	<p>Version 2</p>

BIM4WATER



With the Data Core forming the heart of a decoupled architecture, this now allows for systems and infrastructure around it to be migrated into it over time in a piecemeal and controlled fashion.

