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Enhancing Efficiency and Collaboration with the Treatment Plant Engineering Solution

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The water sector faces a myriad of complex challenges in the engineering and construction of new water treatment plants. Foremost among these is the rapidly increasing demand for water treatment driven by population growth, urbanization, and industrial expansion. As our societies expand, the need for clean, treated water becomes ever more pressing, putting immense pressure on existing infrastructure and resources. Furthermore, the sector must adhere to increasingly stringent environmental regulations, which mandate the reduction of pollutants and the conservation of water resources. Compliance with these regulations requires innovative engineering solutions and advanced treatment technologies, which can be costly and complex to implement.

Another significant challenge that water professionals face is the integration of resilient and adaptable systems capable of withstanding the varied and unpredictable impacts of climate change. Extreme weather events, rising sea levels, and shifting precipitation patterns can all disrupt water treatment processes and damage infrastructure, necessitating the development of robust, flexible systems. In addition to these forward-looking considerations, the sector is also grappling with the issue of aging infrastructure. Many existing treatment plants are decades old and require extensive refurbishment or complete replacement to meet modern standards and demands.

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These challenges demand that engineering solutions be both innovative and cost-effective, especially considering that poor plant design more than doubles the overall cost of engineering and delivery within the capital phase of an asset's lifecycle—with knock-on effects lasting well into the operational phase. It ensures that plants can be designed, constructed, and operated with long-term sustainability in mind. Effective collaboration between engineers, constructors, and water utilities is essential for developing solutions that are not only technically sound, but also economically viable. By adopting a holistic approach that considers the entire lifecycle of water treatment plants, from initial design through to long-term operation and maintenance, the sector can better meet the increasing demands placed upon it. Ultimately, addressing these challenges is crucial for ensuring the continued provision of safe, reliable, and efficient water treatment services to communities around the world.

Let's look at two examples of forward-looking organizations who have faced these challenges.

TUAS WATER RECLAMATION PLANT

The Tuas Water Reclamation Plant (WRP) in Singapore is a cutting-edge facility designed to enhance the country's water sustainability. As part of the Deep Tunnel Sewerage System Phase 2 (DTSS2) project, it aims to recycle water to meet long-term needs. PUB, Singapore's National Water Agency, selected Jacobs as the detailed design and construction supervision consultant to manage the integration of digital information across multiple packages during both design and construction.

The project involved handling vast amounts of data from 16 different contract packages, which Jacobs addressed by using Bentley's iTwin® Platform to create a connected data environment. This digital solution enabled real-time access to a digital twin for all stakeholders, optimizing collaboration, reducing forecasted capital expenditures by 5%, and upskilling over 200 personnel. Upon completion, the Tuas WRP will be the world's largest membrane bioreactor facility, treating 800,000 cubic meters of used water per day. This project sets a benchmark for integrated digital project delivery and demonstrates the benefits of digital transformation in large-scale infrastructure projects.

SEAWATER DESALINATION PLANT

The seawater desalination project of Wanhua Chemical aims to support an environmentally friendly, low-carbon chemical park and alleviate freshwater resource constraints, providing Pengali, China, with 90 million tons per year of freshwater resources. Located on the seashore, the project presented poor geological conditions, compounded by complex desalination processes and equipment, along with data integration and exchange challenges. Therefore, the Shougang International Engineering Technology project team wanted to pilot BIM workflows to deliver the seawater desalination plant.

Leveraging Bentley's ProjectWise®, OpenPlant®, and OpenFlows™ software, they established a collaborative BIM environment, modeled the plant and equipment, and simulated and analyzed water hammer and pipeline stress to ensure the safety and reliability of the system. Bentley's integrated digital solution streamlined workflows to improve design efficiency by 70% and shorten the design cycle by more than 50%. Working in a connected digital platform, they identified and resolved 247 design conflicts, saving 10% of materials to reduce engineering waste and shorten the construction period. The 3D models provide the foundation for intelligent digital seawater desalination operations.

BENTLEY'S TREATMENT PLANT ENGINEERING SOLUTION

Water utilities face an array of challenges that can require an array of solutions. However, water professionals no longer have to wade through endless specialized software to determine what's best to overcome their particular challenges. Bentley's new Treatment Plant Engineering Solution is a comprehensive suite of agile, interoperable, and economically scalable software designed to revolutionize the detailed design and engineering of water and wastewater treatment plants. Built on the foundation of our industry-leading design and engineering tools, this solution enables engineers to perform 3D plant design and modeling, collaborate with multidiscipline stakeholders to ensure efficient and optimized plant designs through seamless interoperability between capabilities, and create a digital twin for use in latter construction and operation phases.

With a focus on "digital twin ready" delivery, the Treatment Plant Engineering Solution facilitates the creation of a plant digital twin from the very start of a project. This digital twin allows engineers to work in an open, intuitive, and collaborative environment, speeding up the design and review processes. By leveraging technology-assisted quality review checks across all disciplines, the solution helps reduce risks in delivering and operating complex

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treatment plant projects. Through this approach, a single consistent digital asset can be created and seamlessly utilised throughout the asset's lifecycle, meaning that operations engineers can see design context many years into the future, enhancing their understanding and ensuring that future works consider the full asset context.

The Treatment Plant Engineering Solution offers a multitude of capabilities that empower engineers to meet the demanding requirements of modern water treatment facilities. Through its advanced 3D design and modeling tools, engineers can create detailed and accurate representations of treatment plants, allowing for precise planning and optimization of every aspect of the facility. This robust modeling capability ensures that potential issues can be identified and addressed early in the design phase, minimizing costly rework and delays during construction.

Moreover, by utilizing the digital twin, project teams are enabled with real-time collaboration among multidiscipline stakeholders, including engineers, constructors, and water utilities. This interconnected environment fosters greater transparency and communication, ensuring that all parties are aligned and informed throughout the project lifecycle. By providing a single source of truth, the digital twin helps to streamline decision-making processes and enhance overall project efficiency.

Another significant benefit of the Treatment Plant Engineering Solution is its ability to integrate technology-assisted quality review checks across all disciplines. These automated checks help to identify and mitigate risks associated with complex treatment plant projects, ensuring that designs comply with regulatory standards and best practices. This proactive approach to quality management reduces the likelihood of errors and omissions, leading to safer and more reliable treatment plant operations.

Furthermore, the solution's seamless interoperability between various capabilities allows for the efficient transfer of data and information between different software tools and platforms. This interoperability is crucial for maintaining consistency and accuracy throughout the design, construction, and operational phases of a treatment plant's lifecycle. It also enables engineers to leverage existing data and insights, enhancing the overall efficiency of their work.

In addition to its technical capabilities, the Treatment Plant Engineering Solution is designed with economic scalability in mind. This scalability ensures that the solution can be tailored to the specific needs and budget constraints of different projects, making it accessible to a wide range of water utilities and engineering firms. By offering a flexible and scalable solution, Bentley helps to democratize access to advanced engineering tools, driving innovation and excellence across the industry.

Ultimately, the comprehensive suite of tools and capabilities provided by the Treatment Plant Engineering Solution empowers engineers to design and operate water and wastewater treatment plants that are not only technically sound but also economically viable and sustainable. By embracing this solution, the industry can address the myriad challenges it faces and ensure the continued provision of safe, reliable, and efficient water treatment services to communities around the world.

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