



# Digital twin technology and how it works



## Background

### What is a digital twin?

A digital twin is a process virtualisation program that uses historical performance and real-time data of the physical product, process, or service to create a 3D representation. Data is able to flow between the physical and digital versions of the product, providing opportunities to monitor and analyse the system before problems occur, and also to predict the future performance of a process or product. Interaction between the digital twin and the physical asset is an iterative optimisation process.

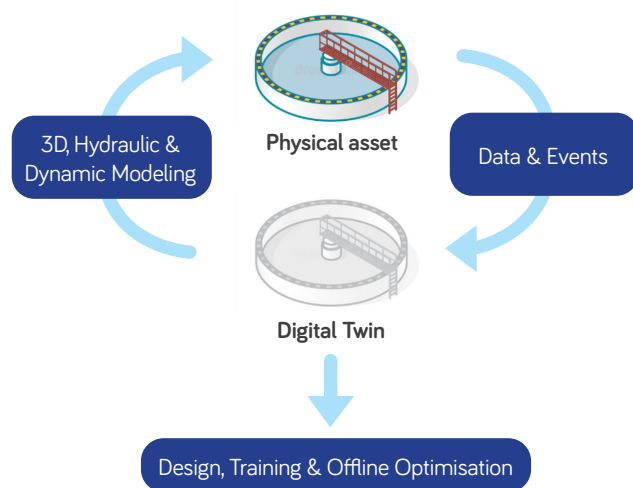


Figure 1: Integration of the digital twin and the physical asset.

### Benefits

One of the main benefits of digital twins is that it connects the real to the virtual, which allows for real-time simulations. The virtual plant has no physical constraints, and can include additional hardware, sensors, pumps and other equipment, at no extra cost. The most efficient or optimised digital scenario can then be implemented on the physical system, saving time and cost.

### Challenges

The main challenge around digital twins, and indeed any form of digitalisation or digital transformation, is information sharing and security, both internal and external. Data security is paramount to a company's continued profitability, and various levels of cyber security are required. Other challenges include establishing communication at all stages of the design, commissioning and operation of a physical asset

### Facts:

- Digital twins can prevent potential future problems in the plant by analysing real-time data of the processes and systems.
- Digital twins can safely simulate extreme conditions such as emergency shutdown, extreme low or process conditions, and equipment failure scenarios.
- Digital twins have been used extensively in the mining, IT, oil & gas, defence and automation industries, where the use of this technology has generated significant savings.
- Digital twins mimic the look and feel of the physical system, and debottleneck the equipment for efficient and robust process design, testing and personnel training.
- Simulation outcomes can be fed back to the physical system for real-time, online process optimisation.

### Future directions:

- Digital twins will be used increasingly in the water industry for process design and optimisation, simulation and prediction, and business, financial and process decision-making.

with an associated digital twin to ensure that appropriate permission, policies and procedures are implemented and enforced. Digitalisation is a fast-growing market, with a lot of new players but not yet a lot of experience. Careful choice of a software solutions partner with expertise in digital twin technology will optimise cost, delivery, maintenance, data management, and security.

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## Industry examples

Industry	Company	Example	Outcome	Reference
Healthcare	(various)	Using historical hospital data on treatment timeliness to develop a supply chain-type model for patient movement through the system	Improved system efficiency patient outcomes	[1]
Oil and Gas	BP	Using real-time data to link and model oil and gas facilities	Improved production and personnel efficiency	[2]
Mining	Newcrest	Combining digital twins and artificial intelligence in a maintenance planning system	Improved operational efficiency, reduced maintenance time	[3]

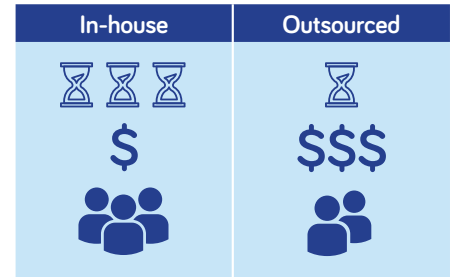


Figure 2: Comparison of time, financial and personnel costs associated with in-house or outsourced creation of a digital twin.

## Cost and time input and savings

Digital twins are relatively new, but have already had a positive impact in many industries, with significant boost to production, time and cost efficiency. However, creating a digital twin also takes time and financial investment. If the twin is designed and developed using in-house resources, the financial cost may be offset by using existing personnel, but in-house expertise is likely to be lower, therefore the overall time and personnel cost may be higher. Conversely, if the digital twin is commissioned from an external source, you might pay more for their expertise and experience, but the product may be delivered in a timelier manner. It is also likely that some time will need to be invested, even when the digital twin in commissioned externally, as data supply, in-house knowledge, and ongoing maintenance of the digital asset will need to be considered. Overall, implementing a digital twin does take time and financial investment, but these are offset by improved plant efficiencies.

## Digital twins for the water industry

Customer perception and attraction of professional talent of the water industry could also benefit significantly from implementing key digitalisation technologies, including digital twins.

Digital twins represent a significant advancement and potential transformation of the water industry, and offer advantages that are being realised every day in other industries. Depending on the level of connectivity between the digital twin and the physical system, they can provide dynamic process simulations, real-time process optimisation and troubleshooting support. As with other industries, so too is the water industry turning to digital twins to benefit their ongoing operations, improve planning, and enhance operator training.<sup>4</sup> Digital twins reduce risk, optimize operations, and manage water-related infrastructure (e.g. storage tanks, pump stations, treatment facilities, and pipe networks). Digital twin can also be connected to enterprise systems, such as process design, maintenance and planning, project proposals, staffing and personnel movement, budgets, production, and logistics.

A digital twin can reduce ongoing operating costs. For instance, The Joinville project team in Brazil used a digital twin to conduct hydraulic simulations of their water distribution network, enabling them to optimise and redistribute

their supply to resolve shortages in the region at an implementation cost of AUD 60,000<sup>5</sup>. Digital twins are applied to design new assets or upgrade existing facilities, too. For example, modelling the filtration process with various configurations, including additional sensors, valves, and filters, to optimise the product quality prior to implementing the design.

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## Further information

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