

WHITEPAPER

Engineering the plant of the future: Balancing sustainability, digital transformation, and efficiency

Engineer new projects and transform existing plants to create sustainable, digital, and future-proof facilities

Authored by:

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Executive summary:

As industrial plant and marine players accelerate digital transformation initiatives, focus remains on driving efficiency to stay profitable and competitive amidst complex challenges and eroded margins. Meanwhile, the energy transition is continuing to accelerate as the world responds to mounting climate change challenges. Environmental, Social and Governance (ESG) priorities are mounting, fueled by growing regulatory requirements and shifting market demands.

The need for efficient, data-driven, and green facilities is growing, increasing the pressure on the process and marine industries to transform how they engineer, build, and operate new and existing plants. Owner Operators and Engineering, Procurement and Construction companies (EPCs) now need to build clear strategies, powered by digital twins in the cloud, to empower the connected worker to drive sustainable outcomes and increase engineering efficiency and operational agility by connecting data, people, and processes.

This whitepaper explores why a market that is more open to change than ever before is looking to drive resilience and embracing the plant of the future. It explores how future plants will operate, the key factors the industry must consider, and strategies to achieve the end goal of sustainable, efficient, modern plants and ships that are fit for purpose in the future.

The good business of efficiency and sustainability

Project and plant efficiency remain paramount

McKinsey estimates that digital adoption in the industrial sector grew six to tenfold in 2020.¹ Once a laggard in digital transformation, the process plant and marine industries have experienced transformative change in recent years, accelerated by the pandemic. EPCs leveraged cloud-based and subscription models to enhance flexibility in a rapidly shifting landscape, and Owner Operators embraced digital twins and collaborative platforms to empower the remote connected worker to improve transparency, enhance decision making and reduce project risk.

Cloud computing adoption is sky-high:
By the end of 2020, 67% of enterprise infrastructure will be cloud-based.²

Future-focused organizations are addressing historically squeezed margins and high project costs by creating efficiencies across the asset lifecycle and incorporating agile, flexible workflows through data-centric working.

New business models are blurring contractual and data boundaries. As a result, the industry is rapidly innovating to enable collaborative workflows that eradicate functional and commercial silos. With the ongoing implementation of Industry 4.0 and emerging human-centric Industry 5.0, efficiency gains remain paramount to forge a solid footing for what is to come while ensuring a sustainable pathway for the future.

Industry outlook

Although the drivers for industrial sectors may vary, the need to optimize performance remains constant, as does the route to the Digital Twin.

The **Energy industry** is constantly exposed to market volatility while also addressing everchanging environmental and safety issues. As they navigate the energy transition towards Net Zero initiatives, players will depend on visibility into their business and operations to quickly understand how different scenarios impact their value chain.

The **Chemicals industry** is more competitive than ever, facing a highly dynamic market while seeking ESG targets. Today, chemical companies must implement technology to become agile and increase sustainability and the circular economy (Figure 1), being ready to thrive in any situation.

In the **Marine Industry**, increased regulation, aging assets, and high operational costs have led to challenging market conditions. Digital technologies, like the digital twin, are enabling marine leaders to protect margins, automate manual processes, improve safety, and improve operational efficiency.

Digital Transformation is leveraged by leading **Power** companies to increase asset utilization and accelerate value generation. Large-scale modernization efforts are underway on aging assets to improve sustainability, transition to renewable energy sources and provide reliable power amidst rising demand.

To meet the demand for greener energy and move towards more sustainable business operations, the **Metals, Mining, & Minerals industry** must shift to digital processes that optimize operations to promote safer and cleaner work for employees, local communities and the land on which it operates.

While global sustainability initiatives accelerate

China's recent pledge to reach net-zero emissions by 2060,³ the European Union's (EU) Green New Deal,⁴ and the USD 2 trillion clean energy plan proposed by the US⁵ highlights that the world's three biggest economies are committed to a sustainable future. Keeping the global temperature rise below 1.5°C will take more than government regulation and incentives, and the industrial sector needs to continue to step up to help accelerate the path to Net Zero.⁶

To navigate the necessary transition to a more sustainable future, the industrial sector must take a multi-faceted approach; from driving a circular economy throughout the value chain (Figure 1), to electrification, and a renewed focus on renewable energy, Net Zero and carbon capture facilities.

The shift to greener operations is not only essential for brand reputation – it has also become a key pre-requisite for gaining regulatory approval and securing funding. Recently, leading investment companies like

“The growing body of evidence showing that higher sustainability performance means better financial performance is steadily gaining traction with investors... 90 percent of studies in this area found that high environmental, social and governance (ESG) standards reduced companies' cost of capital, and that 80 percent show a positive correlation between stock price performance and good sustainability practices.”

- Better Business, Better World⁹

Blackrock^{7,8} have made commitments to extend funding exclusively to companies demonstrating progress against their specific ESG initiatives going forward. Sustainable processes are not just good ethics, they're also good business, and will join efficiency as a critical imperative on the path to the plant of the future.

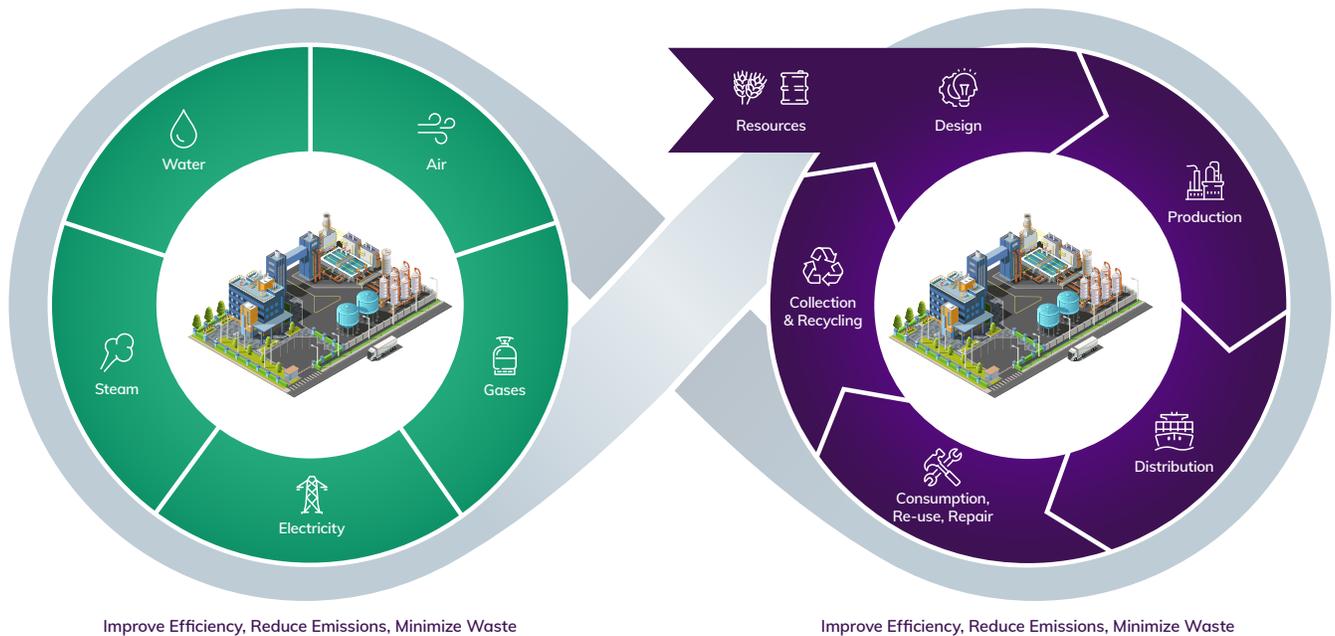


Figure 1. Sustainability requires a broader view. The Circular Economy spans across both operations and asset development lifecycles and focuses on improving efficiency, reducing emissions and minimizing waste across the WAGES and materials loop.

Digital Twins will lead the way

Addressing efficiency and sustainability is critical to the future of the industrial sector, but organizations can only improve what they can measure. Digital Twins provide actionable insights, which are largely used today to reduce risk in the project phase and support maximum efficiency and agility in plant operations.

But there is so much more a Digital Twin can do. For example, a reduction in material waste decreases both costs and carbon impacts, but if the data is not configured in a way that provides the necessary insight for this type of inefficiency, the opportunity to identify both efficiency and sustainability outcomes simultaneously is fleeting. Aggregating all engineering and operational data centrally over time (often called the digital thread) mitigates risk of common oversights that occur when data is spread across multiple, disparate systems. And finally, adding in models and analytics to describe the behaviour of operational assets creates the 'brain' of the digital twin, enabling it to predict what may occur in the future and provide proactive guidance on how to respond for the best overall outcomes.

With all the information at hand, the same data core used today to drive efficiency can be leveraged to help organizations make more informed, sustainable decisions and improve waste reduction.

42%

Digital Twin
Market Growth

The global Digital Twin market size was valued at USD 5.04 billion in 2020. It is expected to expand at a compound annual growth rate (CAGR) of 42.7% from 2021 to 2028¹⁰

While each plant and project is different, the journey to engineering the plant of the future commonly falls within one of four main paths, all underpinned by the Digital Twin:

1. Engineering sustainable, digital greenfield plants

Innovative, sustainable, digital plants built today are designed to last decades into the future. Net Zero, carbon capture and storage, hydrogen production and renewable power generation facilities will depend on digital insights to provide performance insights and track sustainability KPIs. They will be designed for optimal efficiency and sustainability, reduced emissions and waste. Once the project is complete, the core of the Digital Twin and the beginning of the Digital Thread will be delivered to operations at handover.

2. Executing efficient, digital capital projects

With net-new assets of all types, sustainable goals will begin to apply in the early design phases allowing optimization of not just the final plant design and process, but also the project execution process itself. Executing capital projects on time and budget still matters, but now, minimizing carbon impact is an additional critical factor for plants executed today.

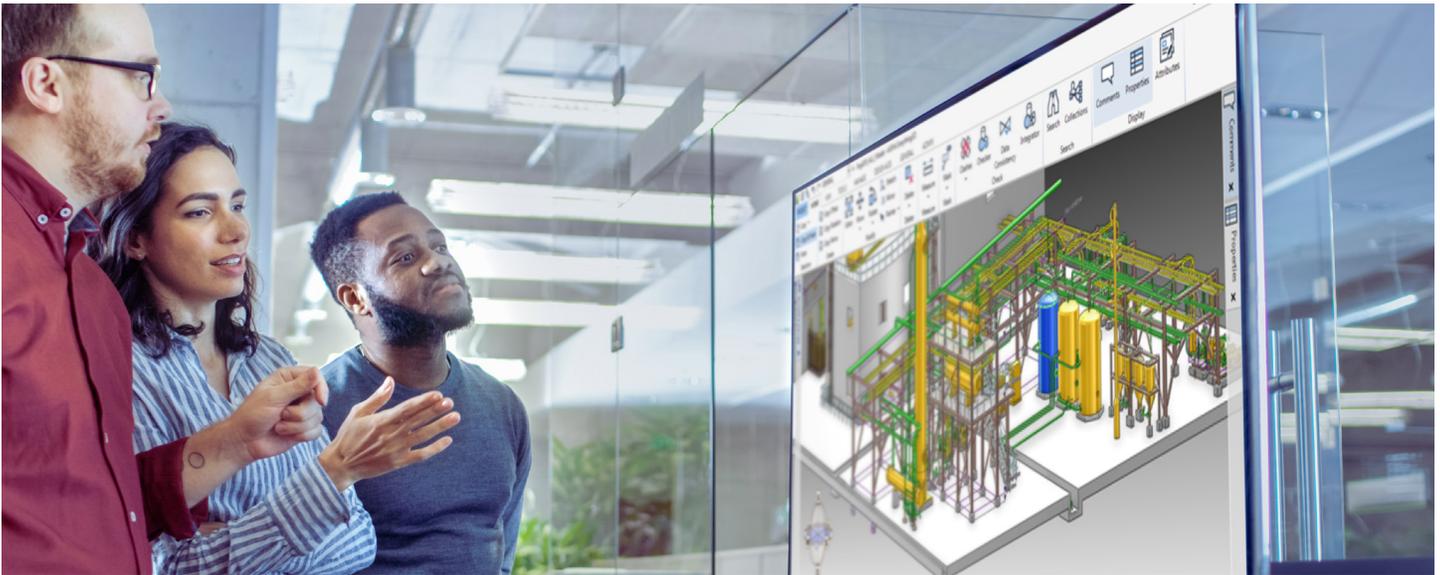
In this scenario, capital project teams must increase efficiency and remain laser focused on reducing cost and risk. Time and cost savings, in turn, will allow more time to be spent on innovation for sustainability and tackling complex problems. Teams can better prepare for what is next by increasing engineering efficiency and improving project transparency, collaboration and decision making by maintaining Trusted Engineering Information (Figure 2) – engineering tools and asset data – in one place in the cloud. This, in effect, is an early phase of the Digital Twin.

“The cost per tonne of the capacity installed during a revamp is about 20–50% of that for a grassroots facility. Such projects are therefore even more relevant in the new reality.¹¹”

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Nick Flinn,

VP, Technology Licensing and Services, Shell



3. Transforming brownfield plants to connected, digital facilities

Legacy plants need to transition into connected, digital facilities to extend asset life and ensure continued compliant sustainable operations. Whether part of a revamp project or an effort to improve operational efficiency – plants must capture a digital representation of the facility (Figure 2) to future proof and optimize processes, train operators and connect workers to digital insights at their fingertips.

4. Maintaining the digital twin to operate safely and sustainably

To maintain decision making and insight integrity, plant operators will depend on reliable digital insights – powered by the Digital Twin – that help them operate safely and sustainably. Whether handed over from the project or captured at a point in time after the fact, maintaining the integrity of the digital thread requires that the engineering data warehouse is kept up to date over time.

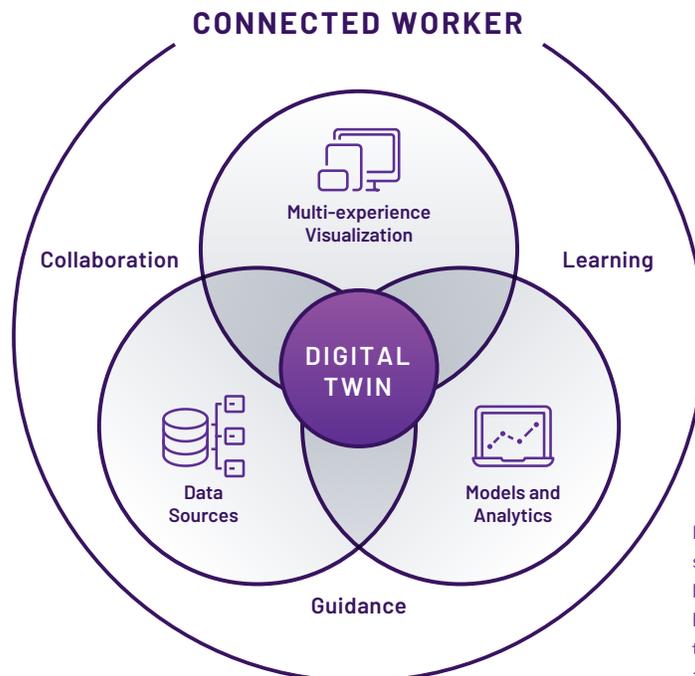


Figure 2. Digital twins integrate data sources (engineering) with models, behavioral (process) and real-time, historical data (operations) to empower the connected worker using powerful 3D visualization.

Turn challenge into opportunity

The challenges of engineering the plant of the future are relatively undisputed, and the opportunity for improvement is just as clear. According to Deloitte, digital transformation provides an opportunity to gain safety, efficiency, and significant financial benefits, including a five to ten percent reduction in build costs and a whopping ten to twenty percent reduction in operational costs.¹² In Reinventing construction: A route to higher productivity, McKinsey uncovered that through productivity improvements the construction industry poses an opportunity to boost global value added by \$1.6 trillion.¹³

Integrated Platforms Become Digital Twins: IDC projects that by 2022, 40 percent of Internet of Things (IoT) platform vendors will integrate simulation platforms, systems, and capabilities to create Digital Twins, with 70 percent of manufacturers using the technology to conduct process simulations and scenario evaluations.¹⁴

By creating a data-driven culture that connects workers and information in the cloud, EPCs and Owner Operators gain the detailed, end-to-end insights required to quickly identify opportunities to become leaner and greener.

AVEVA will take you there

AVEVA's Engineering and Execution, Simulation and Learning, Supply Chain and Information Management solutions provide Owner Operators and EPCs with comprehensive digital engineering solutions that span every phase of their capital project and into operations. The results speak for themselves, with clients achieving 15% savings on Total Installed Costs (TIC). That equates to USD 150 million of savings on a \$1 billion project.

Digital plant leaders

Aker Carbon Capture is using AVEVA™ Unified Engineering in the cloud to enable efficient and repeatable design of their productized carbon capture units. [Learn More](#)

Promon Engenharia integrated engineering and simulation to synchronize data across engineering disciplines to reduce project engineering hours by 15% in design and simulation. This also enabled differentiation by implementing digital twin technology for its customers in the project phase, and a new revenue stream by offering to maintain the digital twin in operations and maintenance. [Learn More](#)

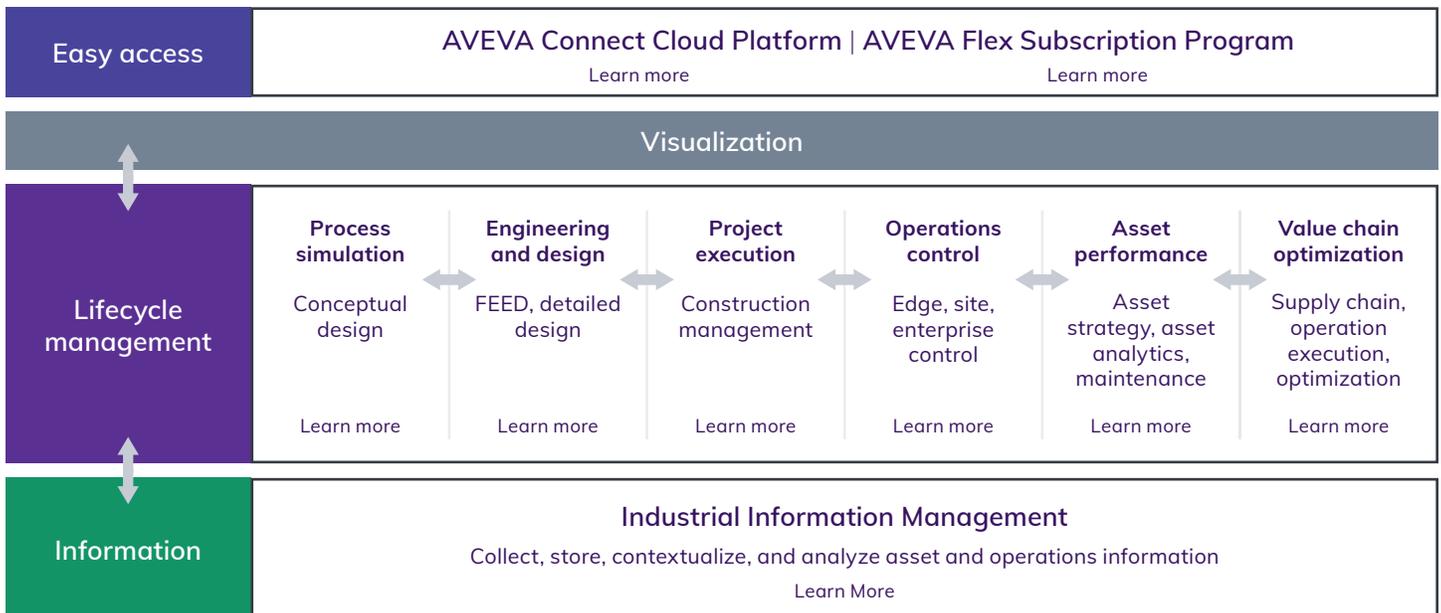
Veolia Water Technologies turned to AVEVA Unified Engineering on AVEVA™ Connect cloud platform to align its engineering teams who are spread across five continents, enhance operational oversight and efficiency, and contribute to Veolia Group's strategic goals of sustainable next-generation water operations and being the benchmark in ecological transformation. The transition from on-premise to the cloud freed up 20% in IT agility. [Learn More](#)

Shell partnered with AVEVA to provide its Engineering data warehouse technology. It enables a common digital thread across Engineering and Operations with the ability to securely deliver information in context from a single source to decision-makers across these critical functions. The platform enables Shell through its Digital Twin to drive asset reliability, enhance efficiency and reduce unplanned downtime. [Learn More](#)



Before a Digital Twin can be developed on brownfield projects or operational assets, all existing data needs to be digitized and connected – from Word documents and PDFs to equipment lists, schematics, and design data. This is captured by AVEVA’s comprehensive Asset Information Management solution, and complemented by a laser scan of the asset to provide an ‘as-is’ 3D model that can be linked to other data points. From here, the process will be the same as if you had built a digitally optimized asset from day one.

All of the components that make up AVEVA’s Engineering portfolio strategy are available on our common cloud platform, [AVEVA Connect](#), and via our flexible subscription program, [AVEVA™ Flex](#). AVEVA Flex allows users to easily scale up and down to respond to dynamic economic conditions and ensure sustainable growth. AVEVA Connect provides a central cloud-based location to access the broadest and deepest industrial software portfolio enhanced by the power of artificial intelligence. Beyond the savings delivered by our Engineering portfolio alone, these offerings drive business resiliency and sustainability for our customers enabling you to transform faster and reduce costs.



The connected, digital plant of the future starts here

Ultimately, whether built new or many years in the past, tomorrow's plants need to be smart, automated, efficient, and connected. Operations, maintenance, engineering, and capital project stakeholders will be connected to a single, trusted hub of data – the Digital Twin – to break down silos, enable collaboration, and facilitate smarter, faster decisions. Integrated process simulations will help project and plant teams identify ways to test and minimize the plant's carbon footprint and deliver a sustainable asset for the long term. And data-driven cultures will enable agile and resilient workflows that distinguish top performers.

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In the end, all this information will become the digital thread used to empower operations and maintenance for many years to come, in ways that have not yet even been imagined.

About the author

Amish Sabharwal is the Executive Vice President for AVEVA's Engineering Business Unit which is responsible for delivering simulation, engineering, design, project execution, operator training and project management software to the Global Industrial Market. Amish has 25 years of experience globally within the Energy, Chemicals and Power industries. Over the past 20 years, he has focused on delivering Digital Transformation outcomes for Owner Operators, EPC and Suppliers by leveraging technology to create value added opportunities to their business processes. Amish is a professional engineer who holds a Masters and Bachelors in Chemical Engineering from the University of Calgary.

Vanessa Erickson is the Global Marketing Lead for Capital Projects Portfolio at AVEVA. She is primarily responsible for thought leadership and customer engagement to enable reduced risk and drive greater efficiency and profitability for AVEVA's Owner Operator and EPC customers involved in CAPEX engineering and execution. Over the past 10+ years, Vanessa has held regional and global sales and marketing roles delivering transformational technology, construction & fabrication solutions to the industrial sector. Vanessa holds a Bachelors of Commerce in Marketing from the University of Saskatchewan.