

Member Communication Experience

Gigawatt Challenge: Infrastructure For The AI Era

Written by: Dana Tilley, Senior Vice President, Advanced Facilities and Market Lead AI Data Centers, Jacobs

We're in the middle of an infrastructure revolution. With data center investments projected to reach \$7 trillion by 2030, the artificial intelligence (AI) era is transforming traditional data centers into complex AI factories.

AI factories are now being planned at gigawatt scale. That means vast power requirements alongside advanced cooling systems need to be co-designed in step with the growing need for compute and ever changing advanced chip design. It also means complexity: AI factories depend on hundreds of companies and specialist disciplines — technology vendors, utilities, regulators, contractors, and operating teams — all working together. Finally, for surrounding communities, it could mean pressure on already constrained power systems. Progress in the AI era depends on addressing these needs.

BALANCING A RANGE OF DIVERSE NEEDS TO DRIVE PROGRESS

Despite this complexity, owners need clarity before committing capital. AI compute requires speed to market, high uptime, and capital efficiency — in AI terms, speed to tokenization. The communities where these facilities are located and the utilities that power them have differing needs and expectations: grid stability, environmental responsibility, and long-term economic benefit.

To address these priorities, infrastructure leaders must respond to a shared challenge: building AI infrastructure at scales ranging from hundreds of megawatts to gigawatts



without destabilizing the very systems that support it. Further complexity lies in the fact that many organizations still rely on the 'plan-design-build-operate' project delivery model. Built for a slower cycle, this model assumes stable requirements and clean handoffs between phases.

With AI data centers, architecture evolves quickly, compute density continues to increase, and cooling strategies are innovating. Developers and project partners need to deliver against these shifting objectives as grid conditions tighten — and communicate to address community concerns.

HOW A VIRTUAL ENVIRONMENT DELIVERS REAL-WORLD ADVANTAGE

Digital twins aren't new. However, their ability to model gigawatt-scale AI data centers as fully integrated systems at a level of speed and fidelity not previously achievable is

a step change. In a linear model, constraints often appear late, when designs are locked in, and capital is committed. In contrast, digital twins provide a way to understand the entire system before decisions are irreversible. Balancing speed and stewardship, digital twins have moved from 'nice to have' to necessary.

At their most effective, digital twins combine three capabilities in one environment:

- » A high-fidelity 3D replica of the facility
- » Simulation ready (SimReady) assets that lets teams realistically test performance and 'what if' scenarios before they commit to decisions that are hard to reverse
- » Industrial-grade automation – the controls, alerts, and guided maintenance processes that support seamless daily operations.

This integrated approach moves decision-making upstream. Instead of siloed teams running analyses on disparate timelines, stakeholders can test trade-offs earlier using shared facts and models. Advances in high-performance computing and platforms such as the NVIDIA Omniverse DSX Blueprint mean that project teams can place the digital assets into a virtual environment. These virtual environments are true data center digital twins built on physics engines that allow full testing and commissioning of the "systems" before the start of the physical construction.

It allows teams to ask practical questions earlier: what's the material impact if we shift the site's boundary, plan for a heatwave, or design around a floodplain? How do these choices affect power and cooling demand? What happens if a generator fails during peak demand or if load profiles change?

When feasibility, constraints, and scenario testing are brought into a shared environment, there's potential to compress early-stage work that often takes six months to a year into just weeks. Of course, high-quality simulation depends on a deep understanding of how infrastructure is designed, built, commissioned, and operated – and on the organizational readiness to put those insights into practice. The real value lies in combining advanced virtual modeling with deep domain knowledge and real-world project and operational expertise. The digital twin becomes a decision-making tool from the outset, rather than a simple visualization.

A GAME CHANGER FOR DEVELOPERS, UTILITIES, AND COMMUNITIES

For AI factory owners, digital twins inform capital decisions and projected costs of operation. The solution provides clarity by addressing two underlying sectoral challenges: how to control costs and how to anticipate future operational requirements.

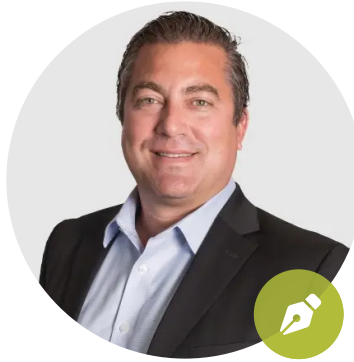
At the planning stage, digital twins can make design trade-offs visible sooner across core infrastructure requirements such as power, cooling, and redundancy, as well as cost. Once up and running, the same digital environment can evolve to provide performance insights to deliver cooling and energy efficiencies. Crucially, data center performance and community impact are coupled: the choices that shape uptime and cost also shape how a facility cooperates with the local grid and efficiently use water systems. Digital twins bring those constraints into the same model early enough to change the outcome. That gives owners the ability to move from managing local impacts after the fact to designing facilities that flexibly work within the limited grid power and water systems from the start.

Working in this virtual environment, developers can model a facility's energy demand and water use against local climate conditions, and they communicate the practical design options and strategies that reduce strain on shared resources. Utilities gain greater certainty for electricity and water infrastructure planning, and communities gain confidence that growth is being designed to accommodate local capacity. Ultimately, the digital twin delivers a facility that allows for early planning between reliability, sustainability goals, and speed, has a lower resource and energy footprint and supports the needs of the community where it operates.

BUILDING SMARTLY AT SCALE

We're witnessing the largest buildout of infrastructure in history and the speed of change is hard to overstate. Power demand from data centers is rising four times faster than the growth in electricity demand from all other sectors combined. The question is whether we can build intelligently – balancing speed with stewardship.

Modeling trade-offs early and realistically demonstrating new design options is what turns speed into judgment. That's what it means to deploy capital and AI infrastructure well today, and it's how the industry can build at the scale the market demands, with the responsibility that both require. 



About the Author

Dana Tilley is senior vice president, advanced facilities and market lead, AI data centers at Jacobs. He leads the company's global data centers business, guiding large, multidisciplinary teams to deliver the infrastructure powering the next wave of innovation. With 30 years in engineering and construction, Dana previously led the company's life sciences business in North America and is focused on outcomes that benefit both industry and communities.

About the Article

This article was written for Jacobs online [Insights](#). [Jacobs](#) delivers highly valued solutions for clients by applying capabilities, including industry-leading design, advanced sciences, digital technologies, big data analytics, program- and construction-management disciplines, and operations and facilities management services.

Any views and opinions expressed in this article may or may not reflect the views and opinions of the Construction Management Association of America (CMAA). By publishing this piece, CMAA is not expressing endorsement of the individual, the article, or their association, organization, or company.