Examples of campus digital twin use cases and associated benefits

Campus space management	
Use case	Optimize the usage of lecture halls, classrooms, labs, and other facilities by monitoring occupancy levels, scheduling, and maintenance needs in real time. The digital twin can simulate different scheduling scenarios to maximize space utilization and reduce overcrowding.
Benefit	Increases efficiency in space usage, reduces scheduling conflicts, and minimizes the need for new construction
Energy management	
Use case	Monitor and manage energy consumption across the campus buildings. The digital twin can simulate energy usage under different conditions, such as varying weather patterns or changes in building occupancy, to optimize heating, cooling, power use (e.g., charging points), and lighting systems.
Benefit	Reduces energy costs, supports sustainability goals, and ensures a comfortable environment for students and staff
Emergency response and safety	
Use case	Use the digital twin to simulate emergency scenarios, such as fires, earthquakes, or active shooter situations. This helps in planning evacuation routes, optimizing emergency services deployment, and training staff and students in emergency procedures.
Benefit	Enhances campus safety, improves preparedness, and ensures quicker and more effective responses during real emergencies
Campus planning and development	
Use case	Support campus expansion or renovation projects by simulating the impact of new buildings, infrastructure changes, and landscape modifications. The digital twin can help planners visualize future scenarios and assess how changes will affect traffic flow, utility networks, and campus aesthetics.
Benefit	Enables data-informed decision-making in campus development, minimizing disruptions and helping to ensure that new projects meet long-term goals
Student experience enhancement	
Use case	Personalize student experiences by integrating the digital twin with campus services, such as navigation, event scheduling, and facility access. For example, students can receive real-time updates on the availability of study spaces, dining options, or gym facilities.
Benefit	Improves student satisfaction and engagement by providing convenient access to campus resources and information
Operational efficiency	
Use case	Monitor and manage the performance of campus infrastructure, including HVAC systems, water supply, and waste management. The digital twin can predict when maintenance is required, preventing unexpected breakdowns and reducing downtime.
Benefit	Extends the lifespan of campus assets, reduces maintenance costs, and ensures that the campus runs smoothly
Sustainability initiatives	
Use case	Track and model the environmental impact of campus activities, such as carbon emissions, water usage, and waste generation. The digital twin can simulate the effects

	of sustainability initiatives, like solar panel installations or waste reduction programs, to measure their effectiveness.
Benefit	Helps the university meet its sustainability goals, enhances its reputation as an eco-friendly institution, and engages the campus community in sustainability efforts
Smart campus integration	
Use case	Integrate various IoT devices and smart systems across the campus into the digital twin to create a smart campus ecosystem. This could include smart lighting, automated access control, and connected learning environments.
Benefit	Creates a more efficient, responsive, and interconnected campus environment that can adapt to the needs of students, faculty, and staff
Real-time collaboration and decision-making	
Use case	Provide a platform for different stakeholders, including administrators, faculty, and facility managers, to collaborate in real time using the digital twin. They can make informed decisions on campus operations, event planning, and resource allocation based on the virtual model.
Benefit	Facilitates quicker decision-making, improves collaboration, and ensures that decisions are based on accurate, up-to-date data
Health monitoring	
Use case	During health crises like the COVID-19 pandemic, the digital twin can be used to monitor and manage the health and safety of the campus population. This includes tracking occupancy levels, ensuring social distancing, and monitoring air quality in real time.
Benefit	Enhances health and safety protocols, reduces the spread of illness, and ensures compliance with health regulations
Facility accessibility management	
Use case	Use the digital twin to assess and improve accessibility across campus facilities, such as wheelchair ramps, elevators, and parking. It can also simulate changes to infrastructure for compliance with accessibility regulations.
Benefit	Enhances inclusivity, ensures compliance with accessibility standards, and improves campus navigation for all users
Event planning and management	
Use case	Simulate and optimize event logistics, including venue selection, crowd management, and resource allocation. The digital twin can predict the impact of large events on campus infrastructure and services.
Benefit	Reduces logistical challenges, minimizes disruptions to campus activities, and ensures successful event execution
Asset life cycle management	
Use case	Monitor the life cycle of campus assets, such as furniture, lab equipment, and IT infrastructure. The digital twin can track asset usage, maintenance schedules, and replacement timelines.
Benefit	Extends asset life, reduces replacement costs, and ensures that resources are available when needed
Transportation and mobility	
Use case	Analyze traffic flow, pedestrian movement, and public transportation usage on campus. The digital twin can optimize shuttle routes, parking availability, and bike-sharing programs.
Benefit	Reduces traffic congestion, improves accessibility, and enhances campus mobility

Alumni and donor engagement	
Use case	Showcase campus developments and sustainability initiatives through an interactive digital twin experience for alumni and donors.
Benefit	Strengthens alumni relationships, increases donor engagement, and promotes university achievements
Cultural heritage preservation	
Use case	Create 3D models of historic campus buildings and landmarks to preserve their cultural and architectural heritage.
Benefit	Protects legacy assets, supports educational initiatives, and showcases campus history to the community
Educational teaching and learning	
Use case	Use the digital twin as a hands-on learning platform for students across disciplines such as architecture, engineering, computer science, and environmental studies. It can support project-based learning, allowing students to explore real-world data, simulate scenarios, and contribute to live campus projects.
Benefit	Provides students with practical experience using industry tools, enhances employability, and supports interdisciplinary, experiential learning aligned with real-world challenges