Digital Twins: The Future is Already Here

Digital twins represent the convergence and real-world application of advanced technologies, including IoT, mixed reality, artificial intelligence, and machine learning

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From smart cities combating the effects of climate change to cultural attractions providing a better visitor experience, digital twins provide significant benefits for the built environment. Bentley's Brian Robins discusses how the infrastructure industry is implementing digital twin technologies.

What do you see as the top trends in technology for the built environment?

Digital twins are advancing building information modeling (BIM) and geographic information systems (GIS) to 4D. More specifically, 4D visualization of engineering change is facilitating better decision-making. Smart city planners, administrators, and campus and facility managers can now align performance data and operational analytics in the context of a rich, interactive 4D digital twin. This digital twin makes engineering information accessible to a wider audience of stakeholders through immersive and intuitive user experiences, such as HoloLens and wearables.

From a commercial perspective, there is a great opportunity to reconfigure business models around as-a-service offerings. We are familiar with the examples of GE and Rolls Royce selling thrust or reliability rather than jet engines. Now, we are seeing the same approaches in the built environment and digital cities. Vendors are looking to offer sustainability, security, comfort, accessibility, and energy efficiency. These can and will be offered as-a-service.

What is the potential of artificial intelligence and the Internet of Things (IoT) technology in infrastructure and smart building technologies?

Most organizations today are data rich and insight poor. It is important to present data and, more importantly, insights in the vocabulary and in the context that the user can understand and relate to. Before we can add value to data, it needs to be combined—or federated—from all the different data sources and data feeds from different systems and vendors that exist in every environment. To do that, the data needs to be aligned, meaning that we need a way to bridge the data from different systems before we can interchange analytics. We also need to identify which data is important and relevant. IoT and continuous scanning produce massive streams of data, which can be overwhelming.

How can these technologies positively transform the future of work and societies?

Digital twin technologies are helping us put more intelligence into our built environment. Smart cities are providing a better quality of life for our citizens. When you think that we have to build six new Europes by 2030 to keep up with global population growth and urbanization, and then you consider what we can afford, you realize that the only way we can close the gap is by becoming a lot more efficient at building new cities, as well as making better use of the infrastructure that we already have.

What are some of the opportunities you see in creating smart buildings and cities in areas that are densely populated?

We can create digital twins to simulate the resilience of our cities, especially regarding extreme weather events like flooding and earthquakes. We can also simulate and optimize for water quality and ensure that our drinking water is safe. For example, we worked with a smart city in Portugal to help them with their water network and wastewater to ensure that the city didn't flood and that their beaches were clean.

We can also simulate and optimize pedestrian flows and traffic flows to provide a better livable day-to-day experience. One example is the Eiffel Tower in Paris, which reconfigured the way visitors walk through the tower to avoid congestion and waiting for elevators so they have a better experience.

Why are sensors, their data, and the concept of digital twins so pervasive?

Digital twins with sensors and IoT devices enable us to see what is, sometimes in places that are hard to reach or dangerous to enter. I heard a story about a construction site and of course every construction site is concerned about safety. Someone had left a hammer on the outside of a tall crane and, unfortunately, the hammer fell from a great height and injured a worker. Now, sitting in a trailer, an inspector can monitor the site remotely and ensure that everything is in its right place.

It is the same for industrial infrastructure. If you can avoid inspectors climbing cell towers or flying helicopters offshore to inspect rigs, then it is much safer for employees and, at the same time, also results in significant savings.

Why is being "open" so important when it comes to digital twins?

Every instance of a digital twin is going to involve a heterogeneous mix of vendors, data sources, and use cases. While no one knows what a digital twin is going to be five years from now, it will certainly be connected to more systems than are possible today. The industry wants the flexibility to change as requirements change and as things become possible that were not before. In software terms, that means being open.

Over the long term, open systems win over closed systems. In this context, "open" means that a digital twin is open to whatever engineering applications that engineers are using, open to whatever file systems engineering data is stored in, and open in file formats and schemas.

Bentley's iTwin Services are built around the principle of openness. They are designed to be both open and flexible so that they can be easily used and integrated with other systems.

If you had the opportunity to look into the future, what do you think is the next big transformative trend that we should start paying attention to?

Intelligent agents—such as voice-activated bots—will help with "fast-path" scenarios, e.g. navigate to an open desk or free parking spot. I will be able to track myself and my experiences inside a building in real-time. A good place to learn more about digital twins is http://www.bentley.com/iTwin.