

GIS-powered Digital Twins

Transforming Operations & Decision-Making

A digital twin is a virtual representation of the real world, including physical objects, processes, relationships, and behaviors, making it a perfect digital replica of the physical world. GIS creates the data mesh for digital twins, by uniquely integrating multiple types of digital models – it interconnects information, systems, models, and behaviors with spatial context, thereby creating holistic digital representations of environments, assets, networks, and cities.

Today, the business ecosystem is leveraging the idea of integrating GIS-empowered digital twins for abstracting and modeling everything to enhance business processes, mitigate risk, optimize operational efficiencies, and boost decision-making with automation to predict outcomes. Digital twins tend to serve more purposes, not only for solving business challenges but also for generating economic growth, while simultaneously creating relationships and streamlining workflows. The emergence of Industry 4.0 and IoT has accelerated the adoption of the digital twin technology across industries. Currently, the digital twin technology meets the requirements of various users in government as well as private sectors like telecommunications, utilities, etc. Players in the automotive, aerospace, and defense industries appear to be more advanced in their use of digital twins today, while logistics, infrastructure, and energy players are gearing up to follow suit soon. Organizations across verticals are increasingly exploring ways to deploy digital twins in a variety of ways, including in operations, city planning, smart infrastructure, and much more.

GIS fueling Digital Twin Technology

GIS technology has a very important role in advancing the idea of creating digital twins for the infrastructure sector in the country. Any digital twin of a fixed asset or real-world system benefits directly from including GIS data about the asset or system and its geographic context. Not only can GIS be used to create digital twins of natural and built environments, but it also can be used to integrate many different digital representations of the real world.

Today, retail, manufacturing, supply chain, healthcare, renewable energy, construction, aerospace, and climate change are all being served by digital twins. It has evolved into a tool for developing enhanced virtual, real-time, and AI-driven models of real-world applications, for curating intelligent decisions for real-world problems. For example, as the 5G revolution starts taking shape, it will necessitate a denser telecom network with more judiciously and unequivocally deployed towers.

“GIS data powers many simulations of real-world dynamics and behaviors. 3D GIS provides dynamic, easy-to-use experiences in a web browser for simple analyses. For complex analyses, advanced geoprocessing workflows may be used to simulate changes in large utility networks and then to see those changes in a simple dashboard. Using GIS, one can map the utilities running near the project site, both over and under the ground, and tackle them effectively during construction. It also helps in handling other tasks like finding optimal routes for raw material deliveries and disposing of construction waste and excess material. These decisions can be taken easily using the techniques of GIS.”

This will call for improved spatial analytics - powered by digital twins. Digital Twins that are based on GIS have features that are geo-referenced. These georeferenced features make the digital twin powerful tools for analyzing, visualizing, and simulating geospatial data and phenomena, enabling better understanding and decision-making in various domains such as urban planning, infrastructure management, environmental analysis, and emergency response. Esri offers an array of GIS products that are being utilized for digital twin deployment, including ArcGIS Urban, ArcGIS Indoors, ArcGIS CityEngine, and ArcGIS Reality.

ArcGIS Urban enables planners and design professionals to collaborate across teams with a web-based 3D application that supports scenario planning and impact assessment. ArcGIS Urban enables the digital transformation of city and regional planning to encourage collaboration with community stakeholders and help all groups work toward a more sustainable future.

ArcGIS Indoors enables organizations to build an indoor geographic information system (GIS) and put the power of indoor mapping, wayfinding, and space management software into everyone's hands. With three license levels available, ArcGIS Indoors Pro, Indoors Maps, and Indoors Spaces, organizations can consolidate their asset and space information into a single place, the indoor map, and provide easily accessible web and mobile apps, for location discovery, wayfinding, room reservations, and space planning.

ArcGIS CityEngine is advanced 3D modeling software for creating massive, interactive, and immersive urban environments in less time

than with traditional modeling techniques. The cities that are created using ArcGIS CityEngine can be based on real-world GIS data or showcase a fictional city of the past, present, or future.

ArcGIS Reality is a suite of photogrammetry software products designed to enable reality capture workflows for sites, cities, and countries. With ArcGIS Reality, organizations can turn drone and aerial imagery into visually stunning and highly accurate maps and 3D models. They can interact with a digital world that shows places and situations as they truly are, layered with geospatial data that enriches reality with greater context.

“ There has been a remarkable uptick in the trend of solving real-world problems with customized GIS solutions and resultantly, trends like GeoAI, GIS on Cloud, and digital twins, are witnessing accelerated popularity. The reason behind this accelerated utilization revolves around the numerous advantages they provide for the users, with digital twins resulting in less waste, shorter times to market, shorter development time, and constant customer insights. The technology allows for rapid iterations and optimizations of product designs far faster than physically testing every single prototype. ”

The advantages of applying digital twins become important for government programs like Gati Shakti, as they help in better designs, cost management, multi-agency coordination, and cutting down project timelines. From enabling better planning, management, and governance, to providing improved and secure solutions for industries and masses alike, the digital twin concept is being valued for what it can really do. In all of this, software such as ArcGIS provides out-of-the-box solutions that enable the creation, visualization, and analysis of digital twins.

However, though the digital twin is a cutting-edge technology that has revolutionized the business ecosystem by mirroring almost every facet of a product, process, or service, the technology also faces its share of challenges. These include data standardization, data management, and data security, as well as barriers to its implementation. The high cost of deployment, increased demand for power and storage, integration challenges with existing systems, and complexity of its architecture are indeed slowing down the growth of the digital twin market. These issues cannot be addressed in silos. The government and industry should join hands to evaluate and optimize the performance of physical systems to draw out the most from this technology.

