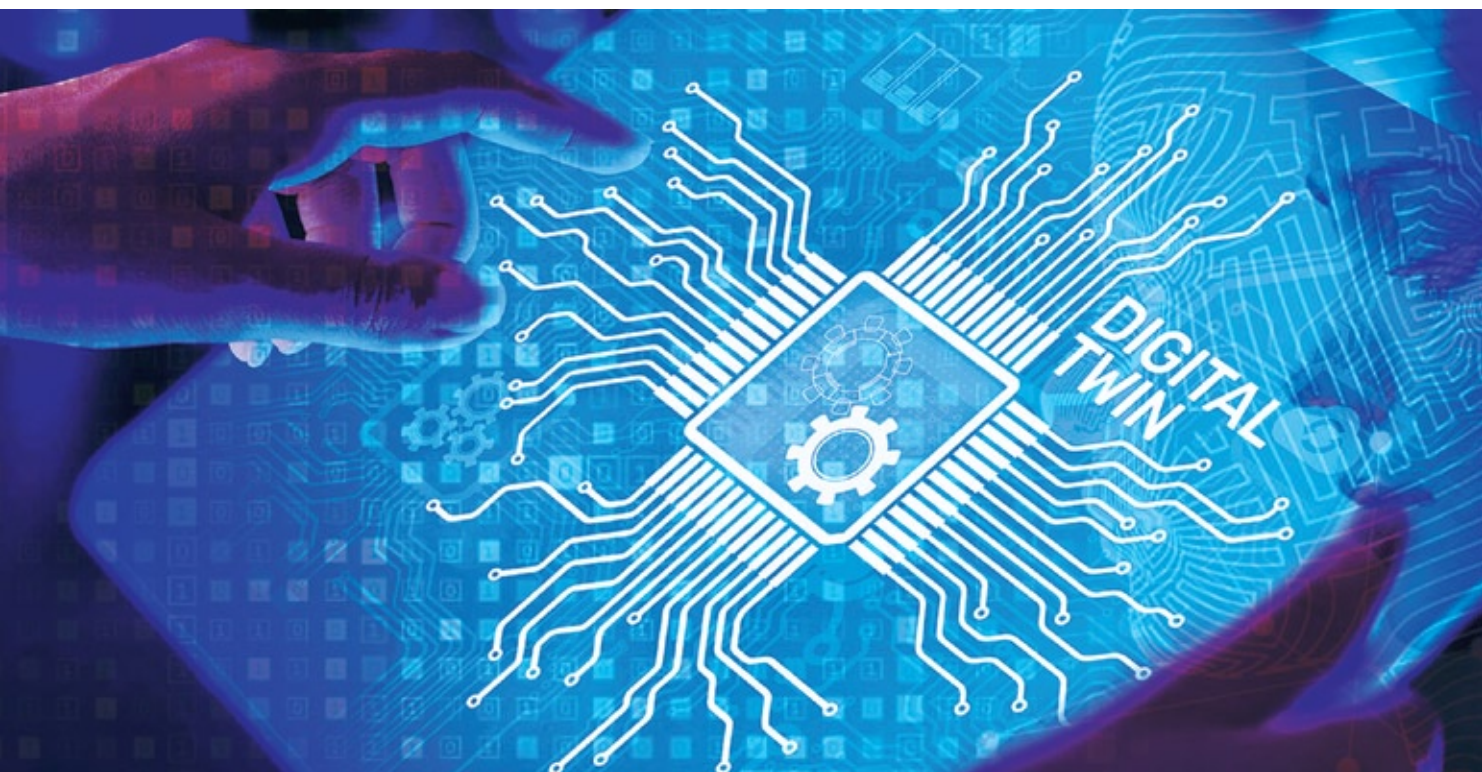


Digital Twins: still infants, but with great promise

This nascent technology allows real-time look at industrial processes. Coupled with IoT and AI, it opens new vistas of improvements and innovations



Imagine a typical manufacturing factory. There would be several units producing various parts, but without synchronisation, working in silos. How can information technology help coordinate them? A digital twin is the answer. For the uninitiated, it is a virtual representation that serves as the real-time digital counterpart of a physical object or process.

COVID-19 has added to relevance of the digital twin technology, which can aid in many tasks such as remote monitoring, predictive maintenance and automated processing. Digital twins enable companies to simulate

their shop floor or their entire business to identify optimisation opportunities.

But keep in mind that it is a concept, not a single product or a piece of technology. Other technologies like 3D simulation, internet of things (IoT), 4G/5G, big data, blockchain, edge and cloud computing, and artificial intelligence (AI) come together to make the concept a reality.

Gartner named it among top trends in 2017. "Billions of things will be represented by digital twins, a dynamic software model of a physical thing or system," it noted.



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The next year, digital twin technology was again named among top trends.

Industries like aerospace, defence, manufacturing, healthcare and pharmaceutical, energy and utility, and transportation have adopted digital twins and more are in the process of doing so. Companies like Bosch, Schneider Electric and IBM are creating ground-breaking solutions using this new technology. Digital twins will help accurately forecasting the future of physical assets in industrial services. Over the years, various IT tools have generated massive amounts of data, not all of which is put to use. A digital twin will extract insights from that.

“The digital age has unleashed limitless potential and is transforming the way we work, play and live. It is offering businesses unprecedented opportunities for invention, growth, and value creation. However, to realise these opportunities, it is crucial that businesses not only develop digital capacities but also put digital at the centre of their enterprises to have more efficient and speedier production systems that guarantee close to zero downtime,” says Pradeep Agarwal, Senior Director, ERP Cloud, Oracle India.

“Today, it is possible with the revolutionary practice of digital twinning. Digital twin has the potential to drive unparalleled efficiencies in Industry 4.0. With India’s thrust on increasing the contribution of manufacturing from 15% to 25% of the total GDP, the sector has an opportunity to increase its overall productivity by accessing valuable data through digitally enabled production lines.”

Kiran Divekar, Director, Manufacturing Applications, Dassault Systèmes India, explains that digital twins can be any element that comes in. “It allows you to do unlimited iterations, provides insights of how your production is

going on, how the human elements can be improved and so on. There is also the integration with the PLCs and knowledge retention.”

Dassault’s 3D Experience platform provides a real-time view of business activity and ecosystem, connecting people, ideas and data in a single collaborative environment that empowers businesses and people to innovate in entirely new ways.

Nisheeth Srivastava, Chief Technology and Innovation Officer – India, Capgemini, says: “We have a solution with Nextgen AR/VR platform that digitises the maintenance, repair and operations activities using cutting-edge technologies for smart authoring, advanced planning and simulation, AR/VR/digital twin and AI.”

He adds, “The digital twin application provides a real-time 3D model of network assets by using advanced AI algorithms to assess the present condition of the assets and predict their future operating trends. This helps the utility managers take early informed decisions to prevent major failures, thus ensuring reliability and quality of service to our customers and exceeding the regulatory standards of performance.”

Rohit Pande, Country Head – AI Applications, IBM India/South Asia says IBM has been involved with digital twins since the Apollo space program. “IBM’s Real-Time Computer Complex (RTCC) was an IBM computing and data processing system at NASA’s Manned Spacecraft Center in Houston. It collected, processed, and sent to Mission Control information that directed every phase of an Apollo mission. The RTCC was so fast, there was virtually no time between receiving and solving a computing problem.”

IBM continues to do a lot of work with digital twin technologies, especially around the IBM Maximo



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solutions. The applications keep growing across different industries. For instance, one of the global innovations has been bringing augmented reality (AR) into asset management.

Javed Ahmed, Senior VP, Global Supply Chain International, Schneider Electric India, adds that they have digital twin at two levels, Asset Twin and Process Twin. “It helps us to plan, do, check and act throughout the lifecycle of asset and process.”

BUILDING A RESILIENT SUPPLY CHAIN BY DIGITISATION

Digitalisation for supply chains is enabling transparency across the entire value chain. Companies are looking to streamline and improve supply chains, but are also under pressure to manage supply chain disruption and meet corporate social responsibility requirements associated with their supply chains.

Industry 4.0 connectivity and digital transformation are creating agile operations that are more capable of responding to disruption and recovering from it.

Nabuath Ulla Khan, Practice Head, IoT Analytics, SAS India, says: “In the current competitive and dynamic market, customer demands and interests are changing continuously, and hence, risk of disruption in the supply chain is also increasing. To be successful in this scenario, supply chain of a firm should be resilient.”

Most firms realise that the specific end goal of developing a resilient supply chain calls for a detailed self-assessment of internal performance as the starting block. While a few large multinationals were already on this path of assessment, the pandemic hit the entire globe, which has thrown almost everyone off guard. This pandemic

impact has driven home the need to address weaknesses of several traditional supply chains, Khan says.

Diwekar says that supply chain has a huge role to play in manufacturing and production activities. OEMs are outsourcing more work to the supply chain. There is need for the supply chain in India to be resilient. Digitalisation will have a big role to play, and there is a strong need for digitalisation within India. “Dassault has a solution for the supply chain. We provide optional accelerators for the MSME segment, so they can quickly ramp up and start executing their production.”

DIGITAL TWINS AND IoT

The idea of connecting different devices into one network has been around since the 1980s. IoT has become one of the most– if not the most – useful drivers for connectivity, efficiency, scalability, time-saving and cost reduction for industrial and manufacturing organisations. The name has been a bit modified to industrial internet of things (IIoT) for Industry 4.0.

IIoT’s collaboration with data science, 3D modelling, AI and ML has given birth to the new revolutionary concept of digital twin. It helps industries save time and sets the groundwork for customised mass production. With it, even highly complex routes can be calculated, tested, and compiled with minimal cost and effort – and in a short period.

Muthumari S, Head of Data science, Brillio, says: “A digital twin is the digital proxy of a physical object or process or device. The growing demand for IoT sensors and AI/ML makes digital twins crucial in maximising efficiency, predicting complex outcomes, avoiding quality issues, rework, and reducing operating costs.”



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“Digital twin coupled with IoT duplicates the physical model for remote monitoring, viewing, and controlling, which continuously adapts to operational changes based on real-time data. Besides providing descriptive decision-making capabilities, organisations can make agile AI predictions by coupling AI with real-time analytics. For example, there could be processes running for multiple hours before determining the success and failure of the batch by manufacturing companies. This helps predict the likelihood of a batch failure and quality issues during run-time with the help of sensor data and AI/ML capabilities.”

IoT is the key to the implementation of digital twin technology, believes Khan. The increasing affordability of sensors, widespread use of Wi-Fi and the data-throughput capacity of the cloud combine to make the application of large-scale digital twin modelling affordable for a range of manufacturers operating in the IIoT space.

“When manufacturers can see real-time data of how their products are operating, they can make dramatic improvements in design, innovation, efficiency and manufacture. That capability enables them to proactively contact end users so plans can be made for repairs or maintenance – heading off the disruption of potentially costly breakdowns,” he adds.

Digital twins have become more complex – connecting not just one asset with another, but also systems of assets or even entire organisations.

ADDRESSING BUSINESS CHALLENGES

With approximately half of industries integrating the use of digital twins, the rest will definitely be losing their competitive edge. CIOs have been – and are – facing big challenges, that digital twins can address and solve.

Digital twins offer great opportunities in various domains of the product engineering process. However, current approaches to the use of digital twins only focus on different separated disciplines.

Ahmed says, “We see a couple of challenges in manufacturing which can be identified and managed using digital twins. Quality challenge is improved by detecting failures and causal factors in advance to reduce non-quality costs and improve manufacturing acceptability in the global market. Downtime reduction by having real-time asset data and ability to simulate and predict failures helps us to reduce machine downtime.”

He adds, “Productivity/throughput challenges are improved by simulating manufacturing process in the virtual environment and optimising by improving cycle time, reducing inventory, improvement safety and ergonomics helps in improving productivity and throughput yield.”

Prahallad CR, Partner- Customer Solutions, Robert Bosch Engineering and Business Solutions, notes that the challenge in the field to invest and build a digital twin to drive targeted business outcomes rests entirely on the accuracy of the data across the spectrum of value, which bridges the physical and digital world at all points along the value chain.

“Top five challenges in building the digital twin include field data sanctity, clear business problem narrative, missing or invisible data narrating an incomplete picture, rare class faults, and the human factor. A digital twin can handle business challenges that are predictable and avoidable, which helps garner useful insights. Engineering insights can help improve OEE, reduce unplanned downtime, reduce maintenance costs, and improve quality. Business insights can help understand asset



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criticality, plant efficiency, and reduce failure mitigation cost by enabling predictive maintenance.”

Digital twins can create conducive situations that open the door to innovation and multiply the possibilities of what can be achieved through collaboration. Enterprises can now establish perpetual connectivity with the industrial infrastructure, which would help cut costs and derive new business models for additional revenue generation.

RELATION BETWEEN AI AND DIGITAL TWINS

Artificial Intelligence, arguably the biggest invention of the century, is triggering a paradigm shift. The first benefit of a digital twin is the ability to produce simulated data. The second benefit is the ability to plan and test new features. Adding AI to any industrial process will make the process more intelligent by getting more accurate data and predictions, and understanding also visual and unstructured data. Digital twins can marry AI to produce something far greater by creating a usable representation of complex systems.

Prahallad adds that digital twin's unique feature is its ability to provide access to its subject from anywhere. This enables monitoring of the asset and allows for the asset to be remotely controlled under human supervision by deploying appropriate feedback mechanisms. A digital twin is powered by sensors, software and services which in turn are connected to data and algorithms.

AI, data analytics, data science are the core elements that are required to build successful Digital Twins for the organisations. Availability of qualitative data, insights churned out of data analytics and improvement measures suggested by data science will help in more informed and faster decision-making during normal, hardship and distress operating conditions.

With its ability to generate and segregate persona-based recommendations, the automated reporting system of digital twin will ensure availability of the right data to the right people at the right time; thus enhancing predictability and improving transparency.

Organisations aspire to have digital twins that provide insights, correlations and comparisons on as-designed, as-built, as-operated, and as-maintained conditions.

Nisheeth adds: “AI and data analytics are increasingly being used for digital twin application especially in automotive, utility and industrial environment. Digital twins can start by replicating a simple product digitally and extend to replicate an entire industry along with several processes associated in the value chain. By connecting the digital and the physical product with help of sensors and technology, the digital twin can help in providing the real-time operational insights of the physical product or process. This data can further be analysed using some intelligent data mining tools, predefined matrix and KPI's to derive meaningful insights. Equipped with all the particulars, features, financials, and metadata of an 'as-is' processes, organisations can create a model of what's happening today – that is, the digital twin.

This model can be used as a testbed for simulating any number of scenarios, discovering hypotheses and prospects for change. This exposes the DNA of the organization and enables it to work pathways for enhanced evolution.

Manufacturers prefer to use digital twins to improve operations such as plant processes and to optimise supply chains. Digital twins reduce risk because mistakes can be made and corrected offline instead of during actual production or in a working facility.