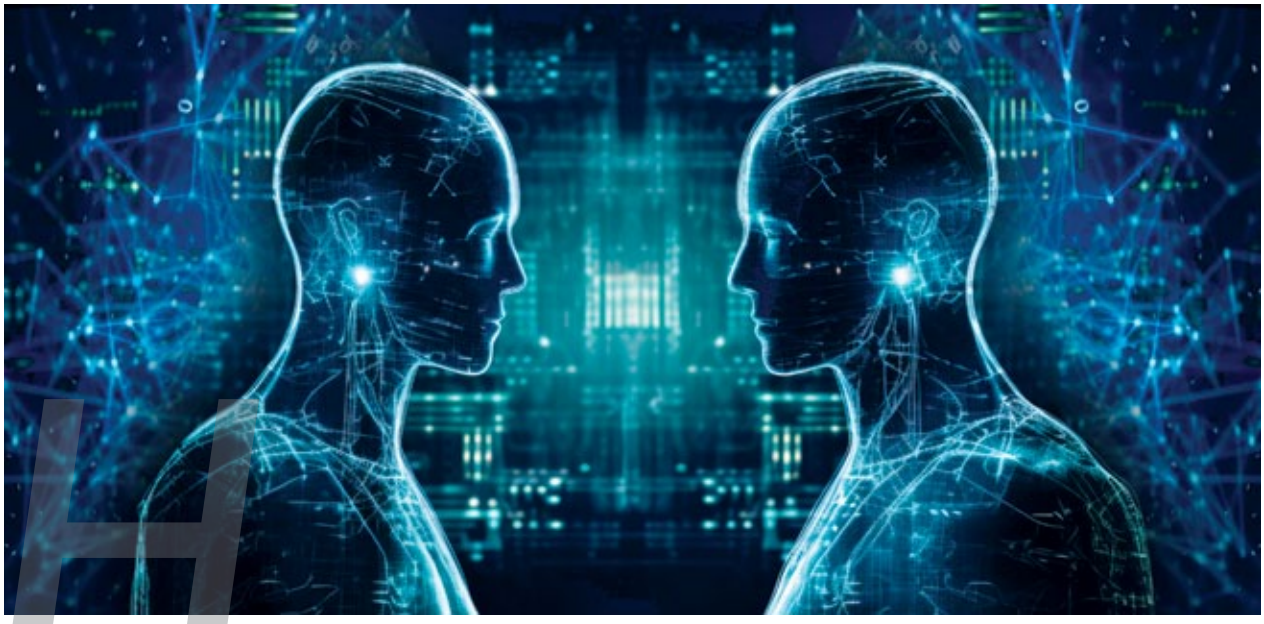
Digital Twins: The Blueprint Becomes the Blue-eyed Boy

Ever wondered why people in offices are seen more around the photocopier or printer rather than their computers?

By Pratima H



Harry F. Harlow's lab was bold, curious and all set to test some prevailing hard-boiled theories of behavioural scientists and psychologists. Especially the ones about letting babies sleep alone. And so arrived the 'surrogate mothers'.

He chose some infant rhesus monkeys and gave them a choice – of course, only after doing some tweaking to these inanimate mothers. One was a simple construction of wire and wood but attached with a milk bottle. The other one was draped in foam rubber and soft terry cloth. But that's that. The cloth version, sometimes, had no food or resources that meant anything to the baby monkey. He even added jolts, barbed spikes and other repellers to this version.

What they found out was surprising but very useful in assessing parent-child contact attachment approaches. The monkeys went up to the cloth replica the most, and again and again! Even after being rejected in some cases. They went back to it.

"With the advent of Autonomous vehicles and advanced ADAS features, the Digital twins play a very important role in simulating the real-world scenarios by feeding them into the virtual vehicle models and refining the performance of the algorithms.

- Sirish Batchu, President and Head of Product Engineering Services, Embitel Technologies

> The potential of Digital Twins to reshape the real estate landscape is immense, and their adoption is no longer optional but essential for those looking to thrive in a data-driven, technology-first world.
>
> **- Sachin Joshi,** CTO of Alt DRX

When they were scared. When they were tired. When they heard a noise. Every time.

What transpired in the Department of Psychology Primate Lab and Regional Primate Research Centre, University of Wisconsin, many decades back was revolutionary, pivotal and hugely instrumental in parenting psychology. However, the experiments also got a lot of brickbats for the way isolation, shocks and spikes were administered with these little monkeys.

Had it not been the 40s or the 60s but 2024, the experiments would have been designed and executed differently. And, perhaps, spared a lot of the criticisms around lack of ethics and sensitivity.

Because today, we have something called Digital Twins. In industries as varied as automotives and real estate. In businesses as versatile as global corporations and SMBs. And being applied for everything you could imagine – from climate control and space-ships to your customised sports car to your home's floor plan. Here's a quick snapshot for all the Harrys in factories, labs and design studios who feel constrained in any way about checking if their ideas are right or not. Why go for the monkey and the wires when you have Digital Twins?

BYE BYE MONKEY WRENCH

Let's start with the real estate vertical.

"Real estate has always revolved around the mantra: 'Location, location, location'. This dual-edged sword is both its greatest advantage and its most significant limitation. Prime assets situated in Central Business Districts (CBDs) inherently benefit from their enviable location. But what about assets outside these prime zones? Success for these properties hinges on understanding the right location, fostering tenant engagement, and driving consistent footfall—a challenge that traditional methods alone have struggled to address." shares Sachin Joshi, Co-Founder & CTO of Alt DRX (a Digital Real Estate Marketplace that dematerialises ownership of real-estate through their FinTech Digital Tokenization).

That's where virtual replicas help so much, and so aptly. This innovation has transformed real estate asset management from a heavy, maintenance-intensive process to a more dynamic and efficient system, Joshi spells out the impact with specific outcomes. "Digital Twins provide a virtual replica of physical properties, enabling stakeholders to optimise operations, reduce costs, and elevate tenant experiences. By creating a dynamic digital mirror of real estate properties, this technology empowers developers, property managers, and investors to unlock unprecedented value. From improving energy efficiency and performing predictive maintenance to enabling immersive virtual tours, the possibilities are vast and impactful."

That's great! But how can we forget the most important playground for these twins! Automotives!

Digital Twins are being used to build virtual vehicle models, simulate vehicle performance, enhance design processes, and ensure quality control in the early stages of the development process in the Automotive industry, shares Sirish Batchu, President and Head of Product Engineering Services, Embitel Technologies.

Bindu Santha Philip, President at Embitel Technologies narrates more about how these twins are steering new-age cars now. "Hyper-personalisation,

> Digital twins enable monitoring of energy usage and operational inefficiencies, which is particularly appealing in industries focusing on green initiatives.
>
> **- Biswajeet Mahapatra**
> Principal Analyst at Forrester

> The digital twin was previously associated with large corporations, namely in automative, aerospace and manufacturing industries. Nowadays, SMBs are adopting this technology mostly in retail, logistics, and supply chain management.
>
> **- Imran Mohammed,** Head - Global Risk and Compliance, Solv

driving comfort and entertainment have also become necessities in today's car. Learning the user preference of an in-use system (released via production), or even during development phases, and the behaviour of the vehicle in different scenarios is invaluable. The ability to feedback real system data into a digital twin- either of the software on edge or of the driving environment mirroring real-world conditions- and seeing the response of the twin is a true enabler."

Raghunandan Pulijala, Assurance Digital Leader, EY Global Delivery Services gives a peek from the financial sector too. "These virtual replicas allow institutions to simulate scenarios, predict outcomes and optimise decision-making. This technology enhances risk management, fraud detection and regulatory compliance by providing detailed insights into financial activities. By improving efficiency and reducing costs, digital twins help financial institutions deliver more personalised services to their customers."

If you thought it is a technology only tapped by the giants, brace up for another major application area. They come in for specific challenges that Indian SMBs encounter when undergoing digital transformation journeys, particularly those related to resource constraints, technological complexity, and cost considerations, unravels Imran Mohammed, Head - Global Risk and Compliance, Solv (a B2B e-commerce platform for digital needs of small businesses). "B2B platforms are looking to offer simple, scalable solutions to these challenges, allowing SMBs to access technologies such as digital twins with minimal implementation costs.

Meetings are changing as well. As Sameer Raje, General Manager and Head, India & SAARC, Zoom Video Communications, Inc. lets on, "In the future, we envision 'digital twins' as an interactive AI that can attend meetings on behalf of users so that they never skip a beat."

HERE COMES THE MONKEY'S UNCLE!

Left alone, Digital Twins were powerful. But add some AI, Quantum and IoT to this mix and it's a new Superman potion altogether.

As Nidhi Gupta, Senior Analyst, Technology Research & Advisory, Aranca observes, new technologies like AI, IoT, and 5G are making digital twins better and more valuable. "These virtual copies help industries like manufacturing, healthcare, and city planning work smarter through better maintenance, real-time improvements, and testing different scenarios."

Joshi affirms that direction. "Digital Twins have come a long way from their early roots in Supervisory Control and Data Acquisition (SCADA) systems to the transformative integration of IoT and AI. Together, these innovations are making the experience of managing and interacting with real estate assets more seamless and data-driven than ever before."

Parul Trivedi, Practice Director, Everest Group cites how AI-powered digital twins can now analyse vast amounts of real-time data to identify potential issues before they occur, optimise operations, and even predict future trends. "This level of predictive capability is revolutionising industries like manufacturing, healthcare, and urban planning. Another significant development is the emergence of multi-domain digital twins. These interconnected digital representations of complex

> We need to be careful about problems like unfair AI decisions, protecting personal information, and the expensive setup costs.
>
> **- Nidhi Gupta**
> Senior Analyst, Aranca

> As to India, there has been a noticeable increase in the trend of pouring resources in research and development with cutting-edge innovations being seen in manufacturing, healthcare, and urban development.
>
> **- Rethesh Nair,** Senior Specialist Infrastructure Delivery, Publicis Sapient

systems can simulate and optimise interactions between different domains, such as physical, cyber, and biological. This opens up new possibilities for addressing systemic challenges, like climate change and supply chain disruptions."

A lot is happening in the Digital Twins space especially in sustainability, AR/ VR integration, and AI/ML integration, points out Biswajeet Mahapatra, principal analyst at Forrester. "Digital twin has also got a boost with the rollout of 5G along with IoT integration. With the rise of IoT devices and 5G networks, digital twins can operate with high-speed, low-latency data flows, enabling real-time synchronisation and monitoring across industries."

What we are witnessing now is the creation of more advanced replicas which not only resemble physical entities that exist, rather can predict events, deduces Rethesh Nair, Senior Specialist Infrastructure Delivery, Publicis Sapient. "These digital twins are becoming more self-sufficient with the ability to get information from the real world and be able to decide on their own. For instance, digital twins of factories can improve the production processes, forecast the chances of some machinery failing, and even create new products. In healthcare, these digital twins are of patients and can be useful in the preparation of individual therapy as well as speeding up the search for new medicines."

Madhusudhan Murthy, SVP, Global Head of High Tech, ISV, and Private Equity Business at GlobalLogic commends how Digital Twins have moved beyond just being virtual replicas; they're now driving predictive and prescriptive insights across industries. "The latest development is their integration with AI and IoT, enabling real-time decision-making at an unprecedented scale."

Gopalan Govindrajen - Advisory Systems Engineer, Dell Technologies also mentions Blockchain as the new factor to watch out for. "By integrating process mining and blockchain, Digital Twins can improve business processes, forecast risks, and optimise compliance. This trend is expected to reshape Digital Twin management and security."

Sidharth Mahalingam - Power Platform Development Manager, SBM Offshore India agrees. "Today, key trends include the use of generative AI for predictive analytics and simulations, enhancing real-time monitoring and operational efficiency."

The twin buffet has expanded to a new breadth and depth as well. Today we can tap not just 'component twins' that analyse, optimise designs – with the ability to check for everything from strain, stress to load; but also 'system twins' which can predict component interactions and capture the complexity of interplay; and 'process twins' that check for defects and enhance productivity.

No wonder the global digital twin market, that was valued at nearly $9 billion in 2022, is slated to reach $137.67 billion by 2030 (Data from Fortune Business Insights).

MONKEY SEE, MONKEY DO – NOT IN INDIA

India's strides in the space of Digital Twins are both ambitious and well-directed. We are not merely 'twinning' with the global developments but are making our own style statements in this emerging edge.

Whether it is the government's 'Sangam Twin' initiative for smarter and faster infrastructure planning; or the PM's 'Gati Shakti' initiative for massive greenfield and brownfield projects; or future factories in the making (the Ola Digital Twin platform on NVIDIA Omniverse, Reliance's new solar panel factory in Jamnagar); or simulations that skip physical ordeals in vehicle testing; or IT companies creating CoEs and solutions in smart farming and automotive simulations (as initiated by TCS and Tech Mahindra); we can see that we are not playing 'catch up' this time against global counterparts. Add Hyderabad Airport's Digital Twin platform, and the massive Dharavi slum redevelopment project to this list, and we know that the sheer creativity, courage and scale of what India is up to here- are simply staggering.

Mahapatra agrees. "India is emerging as a key player in digital twin adoption, particularly in industries like manufacturing, smart cities, and healthcare. Digital twins are used in smart city projects for infrastructure

> India has the potential to become a major player in the digital twin market. The country has a strong foundation in technology, a growing startup ecosystem, and a large pool of skilled talent.
>
> **- Parul Trivedi,** Practice Director, Everest Group

management, traffic management, resource allocation, and urban planning. Digital twins are used to optimise power production and distribution. They are also used in predictive maintenance, and quality control thereby helping in reducing down time and improving productivity in India."

SMBs may improve overall operations by using digital twins to gain important insights into processes, efficiency, workflows, and potential issues before they arise, Mohammed notes. "Additionally, this helps SMBs prepare for the future of their expansion and position them to stay competitive in an increasingly digital economy. The potential of innovative technologies like digital twin being unlocked by this, helps preparing Indian SMBs to compete globally with ease and without resistance to digital transformation."

Indian IT companies are leveraging their expertise to build and export digital twin solutions globally. Initiatives such as smart city projects are driving local adoption, where digital twins help in urban planning and resource management, he notes.

In India, we have seen adoption with the Governmental agencies including Traffic Management, Vehicular Movement Management & control and sectors like Manufacturing with inventory tracking & backorder management, Smart Cities including Fleet Tracking Status, Supply Chain industries for shipment tracking, and Healthcare including Critical Disease and prevention initiatives are starting to explore their potential, Murthy illustrates.

If we can fix the flip side of these twins earlier and better than others, then this edge can be sharpened to a new level.

For instance, while quantum computing could make digital twins more accurate, it uses lots of energy and might make us rely too much on predictions, contends Gupta. "India is getting better at using these technologies, with a strong tech industry and growing knowledge of AI and IoT. Still, the country needs more money and better systems to solve current problems and make the most of digital technology. Creating strong rules about data security and ethical use is also essential."

Data privacy and security are paramount concerns, especially when dealing with sensitive data, Trivedi echoes. "Despite these challenges, India has a unique opportunity to leverage digital twins to address its specific needs, such as improving urban infrastructure, optimising energy consumption, and enhancing healthcare delivery. By investing in research and development, fostering collaborations between industry and academia, and creating a conducive regulatory environment, India can unlock the full potential of digital twins."

Also challenges like infrastructure limitations and skill gaps need to be addressed for broader adoption, Mahapatra suggests.

Batchu, too, calls out how the adoption curve in India is still at a growth stage." Challenges like high implementation costs, limited awareness, and the need for skilled professionals remain barriers."

Poornima Bethmangalkar, Head of the Industrial, Manufacturing, Energy &Utilities Industry Group, Happiest Minds, seconds that. "Challenges like infrastructure readiness, data privacy & security risks and scalability must be addressed for broader adoption."

Turns out that in 1968 Harlow, himself, suffered from a major depression, after his wife's cancer, and started psychiatric treatment in the Mayo Clinic; and it is from one of the wards here that he began making hand-written notes about his journey with depression. An experiment again, or a pit of despair he jumped into for the sake of science? Hard to say. But if digital twins can achieve that level of interstitial structuring, simulation and real-time insights soon, a lot of despair around mistakes can be avoided in the world of enquiry, innovation, research and business. Especially mistakes that cost money, safety, time delays, huge quality-control rejection piles, botched projects, scope creeps, business lags and ill-spent resources. And cute monkeys.

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