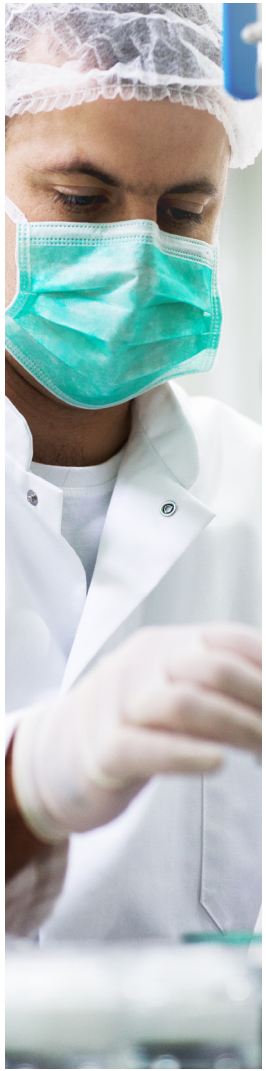

DIGITAL TWIN: BUILDING A VIRTUAL BLUEPRINT

Cambridgeshire, England, home to the University of Cambridge, is all set to lay the foundations of the town's digital twin - a mosaic of street-by-street, minute-by-minute information. Using an underlying IoT fabric stitched with single-purpose sensors and public cloud, the digital twin will allow for not just a visualization of the city's assets but replicate the entire city and its functioning, and give the city authorities the ability to better design city infrastructure and deliver more efficient city services. It would also add significant value to industries such as retail and real estate in the city. All going well, the city will be a showcase of the real potential of the concept of digital twin. However, this concept isn't entirely new and in fact, was used by NASA to develop a digital twin for Apollo 13 to simulate conditions for astronauts while landing on the moon in 1970.

Over the last few years, the concept of digital twin has been used extensively in industries like manufacturing, in recent times, due to reasons including reduced hardware costs, the wide availability of public broadband, and the ability to process different data types on cheap public cloud resources, and it's now beginning to percolate to other industries. These reasons, combined with the recent advancements in Artificial Intelligence (AI) and Machine Learning (ML), have meant that organizations are now able to pursue the dream of creating digital twins for additional efficiencies and to better serve customer needs.

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A recent study by Greyhound Research, a leading global analyst firm, showed that 5 in 10 large organizations (with revenue above USD 1 billion) are keen on using the concept of digital twin to keep up with the demands of the market, scale down business expenses, and improve the durability of physical assets. Most importantly, these organizations are keen to apply the principles of this concept across the product lifecycle to solve perennial, painful business problems and yield quantifiable outcomes. The same study also points to the fact that one of the industries that is very keen on using this concept is pharmaceuticals.

LEVERAGING DIGITAL TWIN FOR PHARMA

Pharmaceutical companies are currently challenged on multiple accounts, including rising costs, expiring patents on blockbuster drugs, declining profit margins, market saturation, need for digitization and agile supply chain models, and stricter regulations. The possibility of solving some of these challenges with digital twin technology makes these organizations keen on experimenting with it.

Pharma companies can leverage digital twin technology to **simulate various operations** in the drug manufacturing process, giving a **real-time** view of the plant's operations, and make sense of the volumes of complex data generated in real-time. This would help process engineers to be better equipped to to visualize the process parameter variation in real time, predict the values of critical process parameters, trigger alerts, and even take corrective actions to improve the performance of the in-progress process. Through our experience of working with some of the world's largest pharmaceuticals brands, we believe digital twin technology has the potential to pave the way for much-needed transformation, thereby giving a **massive monetary upside** for early adopters. Infosys is working to build **sustainable models** of digital twins for pharmaceutical companies, with an aim to drive digitization, along with significant operational efficiencies and lower costs.

A **global pharmaceutical company based in Europe**, an Infosys client, was looking to **optimize the process of cell culture** at their vaccine development plant by predicting the behaviour of the cell culture process in their bioreactors, for which they needed better, **in-context data visualization**. They also wanted to be able to **monitor the process remotely**. In addition, the client wanted an **educational gamification app** as a training solution for the plant personnel.

WALKING THROUGH A BIOREACTOR PLANT

To help the client visualize the cellular culture process and predict the cell concentration levels, we delivered a **Proof of Concept** of our solution – a digital twin of a set of the client's bioreactors. Data that is captured using sensors on various probes on the bioreactors is made **accessible on mobile devices** through the Digital Twin app. Built on **ThingWorx**, PTC's IoT application development platform, the digital twin solution helped the client access data in real time from a secure PTC Cloud. Also, we used **Unity 3D** for enabling **3D visualization** of the entire plant layout and the individual bioreactors, giving an engaging and complete virtual experience on a mobile device of physically walking through the plant.

The engagement helped the client on two key counts:

- **In-context visualization of bioreactor data** - Given that the data generated by the bioreactors was fractured in nature and being sourced from multiple databases, the digital twin enabled in-context visualization and made it easily accessible via the mobile app
- **Predictive power through predictive analytics.** The digital twin solution enabled the client to predict the optimal time to harvest for the vaccine cell culture as well as predict end cell concentration of the culture

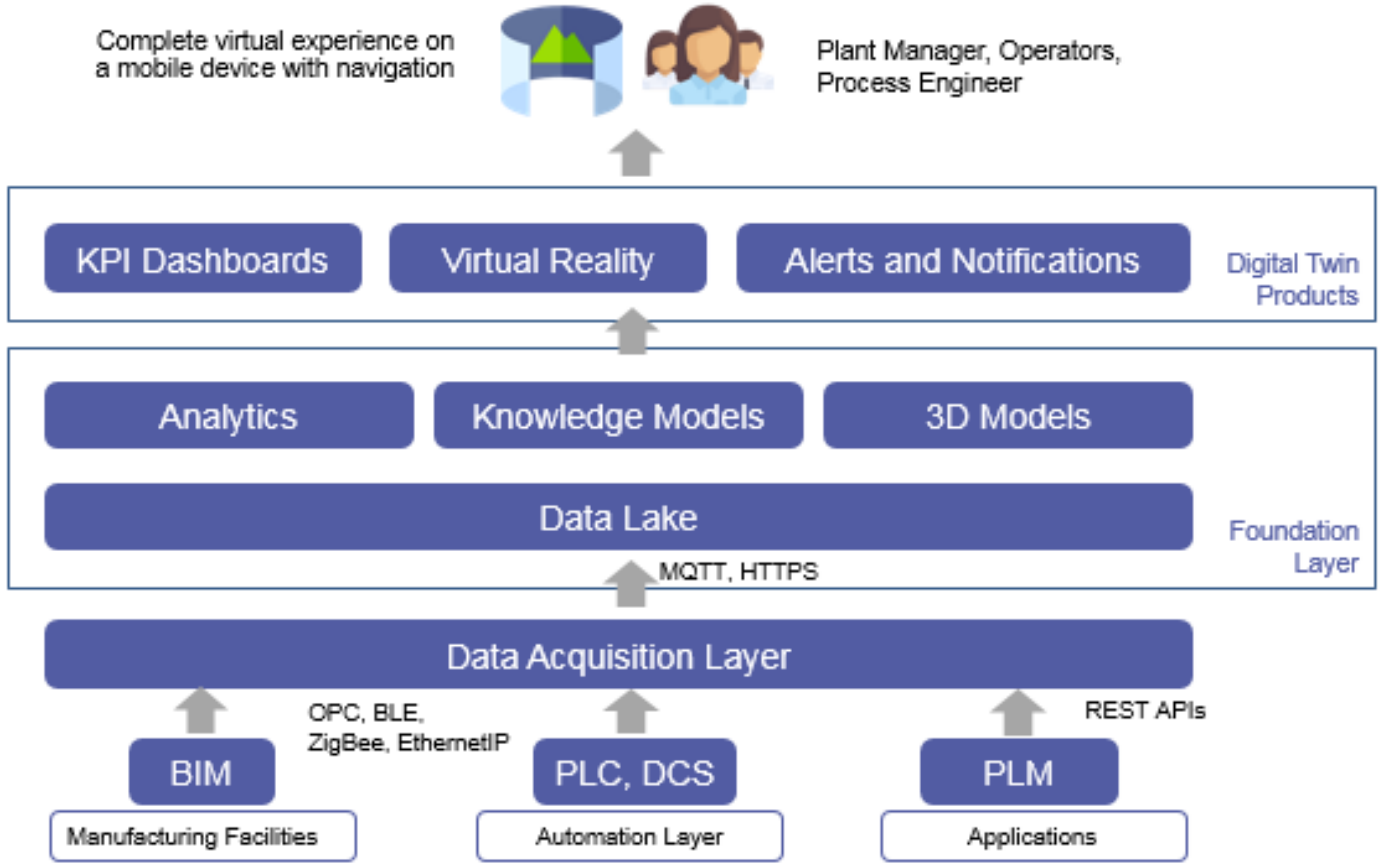
We also built a gamification app for the cell culture process, which could be used for efficient training of personnel. The client found this a very useful learning tool, being non-paper based and interactive.

Both the applications were developed for iOS mobile devices for an immersive and engaging user experience.

The in-context visualization of data and predictive power granted by the digital twin solution had the potential to help the client **optimize and accelerate the cell culture process.** The client can **start predicting batch results right from the third day of culture development process,** as opposed to having a reactive monitoring approach.

In addition, the solution can provide the client several other benefits, including the ability to **remotely manage plant capabilities** and **detect any issues with a particular batch and stop the batch.** It also enables internal teams to better collaborate across bioreactor operations with maintenance, thereby reducing any potential gaps or delays in the cell culture process and helping increase yield.

DIGITAL TWIN: TECHNICAL ARCHITECTURE



DIGITAL TWIN: BUILDING A VIRTUAL BLUEPRINT - THE FIVE KEY TAKEAWAYS

1. **Comprehend** the goals the organization wants to achieve by using the concept of Digital Twin
2. **Collate** data points required to digitally replicate the physical systems and surroundings
3. **Enable** easy access to data findings via mobile devices.
4. **Infuse** technologies like VR for better visualization of data and immersive, engaging user experience
5. **Include** advancements in predictive analytics to train systems to better forecast production and maintenance schedules

BIG LEARNING:

While the importance of Digital Twin as a concept is well understood, its hitherto limited application to real-world use cases and lack of industry-specific experience deters most organizations from taking the leap of faith. However, with organizations unable to solve some of their longstanding business problems and inefficiencies in existing systems and processes, Digital Twin is now beginning to be viewed as a possible answer. For those considering building a Digital Twin, the key is to be aware that it's a long road and one that requires organizations to undergo a culture change, to undergo true transformation.