Digital Twins Simplified

Twinview®

“The concept of Digital Twins has been gaining traction in recent years, particularly in the fields of building construction, asset management, and building operations. Despite the growing interest, many people still find the topic complex and challenging to understand.

To help with this, we have created this eBook that aims to simplify Digital Twins by answering important questions and addressing common concerns while providing a practical guide on how to implement a successful digital twin strategy.”

What is a digital twin?

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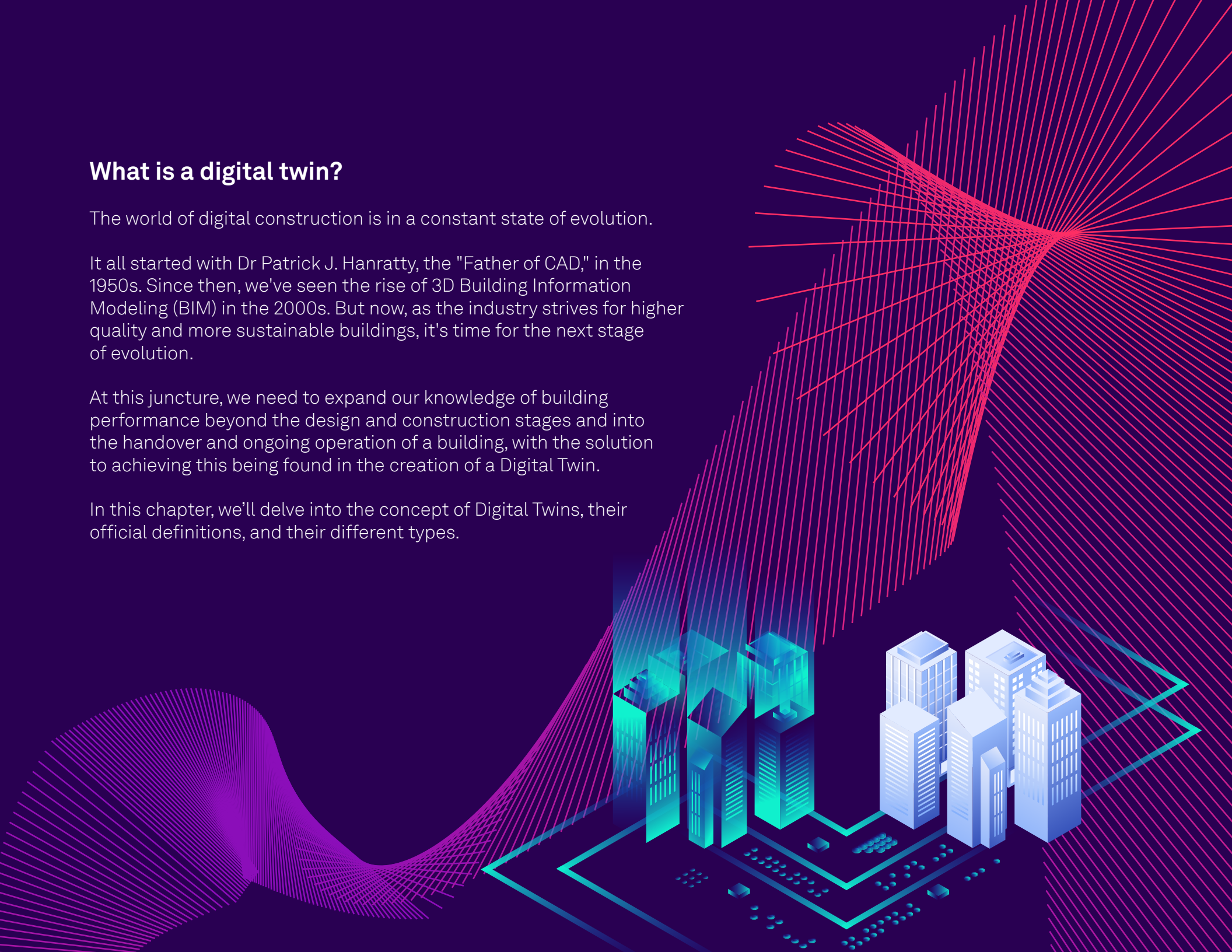
The world of digital construction is in a constant state of evolution.

It all started with Dr Patrick J. Hanratty, the "Father of CAD," in the 1950s. Since then, we've seen the rise of 3D Building Information Modeling (BIM) in the 2000s. But now, as the industry strives for higher quality and more sustainable buildings, it's time for the next stage of evolution.

At this juncture, we need to expand our knowledge of building performance beyond the design and construction stages and into the handover and ongoing operation of a building, with the solution to achieving this being found in the creation of a Digital Twin.

In this chapter, we'll delve into the concept of Digital Twins, their official definitions, and their different types.



So, what exactly is a Digital Twin?

According to the Digital Twin Consortium:

A digital twin is a virtual representation of real-world entities and processes, synchronised at a specified frequency and fidelity.

- Digital twin systems transform business by accelerating holistic understanding, optimal decision-making, and effective action.

- Digital twins use real-time and historical data to represent the past and present and simulate predicted futures.

- Digital twins are motivated by outcomes, tailored to use cases, powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT systems.

But what does all that mean?

In essence, a Digital Twin is a virtual representation of a physical asset that accurately reports real-time changes and provides valuable insight into its performance over its entire lifespan.

Digital twins are tailored to suit specific requirements, each drawing on various data sources, seamlessly integrating with existing business tools and utilising historical and current data to predict future outcomes.

Digital Twins are all around us

While Digital Twins may be relatively new to the construction industry, they are common place in other industries. In fact, the concept itself has been put into practice as early as the 1960s.

Houston, We Have a Problem

NASA used basic twinning ideas when pioneering space exploration in the 1960s, and most famously, on 13 April 1970, they were able to use the data stored in their digital twin of the Apollo 13 spacecraft to model the events that led up to the accident for forensic analysis and exploration of their next steps.

With the digital replica of the Apollo 13 spacecraft and its real-time data, the engineers on the ground, over 200k miles away, could run simulations on potential solutions and understand their impact before recommending them to the astronauts.

The use of digital twin technology has been crucial for NASA to make well-informed and effective decisions on various missions. To this day, NASA continues to rely on this technology, as it remains a key component in their efforts to expand the boundaries of space exploration and discovery.

Digital Twins are all around us

When Every Millisecond Counts

In motorsport, the smallest of details can make the biggest of differences, and this was never more apparent than on 25 October 1997 during qualifying for the European Grand Prix in Jerez, Spain.

During the qualification round, the top three drivers recorded their fastest lap at the same time to one-thousandth of a second. However, due to the timing system's inability to measure within a millisecond, Heinz-Harald Frentzen began the race in 3rd place, despite potentially being the fastest car on the track.

Fast forward over two decades, and every constructor and car manufacturer is constantly searching for that extra millisecond that could have made all the difference back in October 1997.

To achieve this level of performance, digital replicas of the physical cars have been developed, complete with over 300 sensors. This allows teams to monitor every aspect of the car's condition in real-time, as well as its surroundings and how they may impact performance.

When travelling at speeds greater than 220 mph, safety is also a top priority when it comes to Formula 1 racing. That's where Digital Twin technology comes in, using sensors to provide real-time data to on-track medics about a driver's health. This enables them to make informed decisions quickly and effectively, helping to keep everyone safe on the track.

Digital Twins are all around us

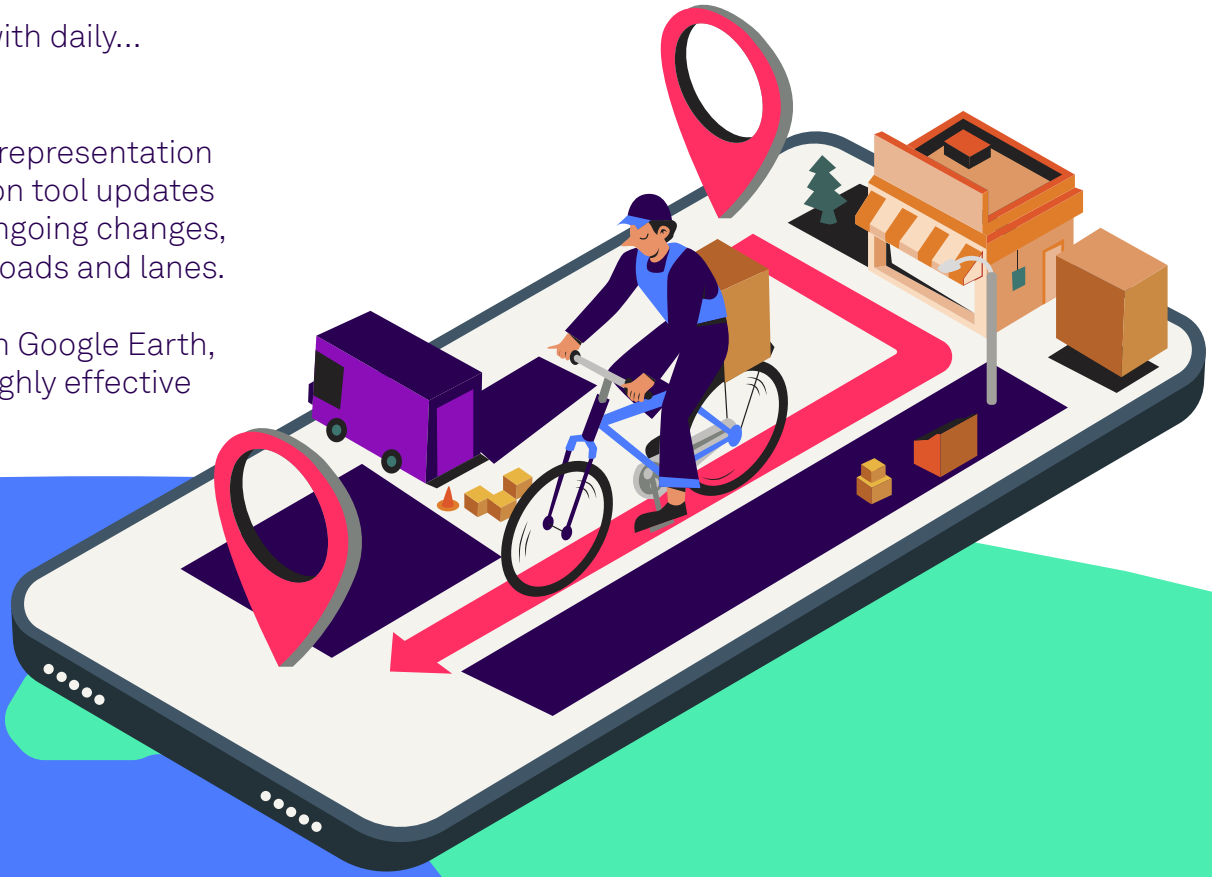
Getting from A to B

Creating a digital twin to improve the performance of an F1 car or to allow for seamless maintenance of a spacecraft that's 200k miles away are good examples of digital twins.

However, there is one that most of us interact with daily... Google Maps.

Google Maps provides a comprehensive digital representation of the global road network. This useful navigation tool updates to show live traffic information and adapts to ongoing changes, such as road closures and the addition of new roads and lanes.

Although there is some 3D functionality through Google Earth, Google Maps is a great example of creating a highly effective Digital Twin using only 2D drawings.

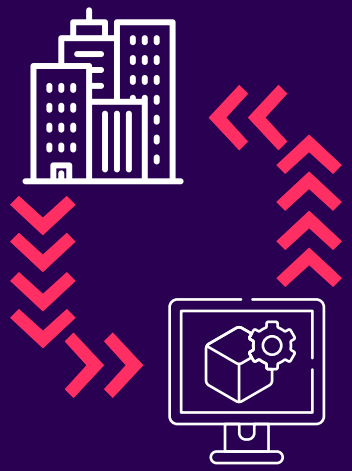


When is a Digital Twin, not a Digital Twin?

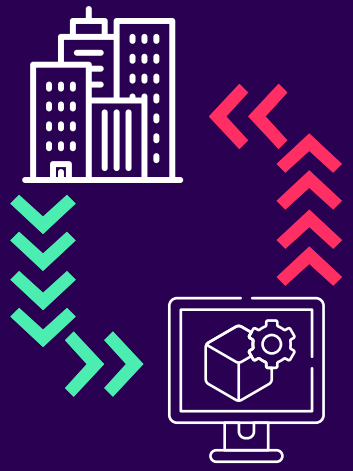
These are all great examples of a Digital Twin, as they provide real-time feedback and evolve as the physical asset changes, but it is important to note that not all digital replicas can be classed as a Digital Twin.

When it comes to digital representations of physical buildings, there are three main categories which common digital replicas fall into. The key distinction between these levels is their ability to exchange data.

Digital Model



Digital Shadow



Digital Twin

Manual Data Flow

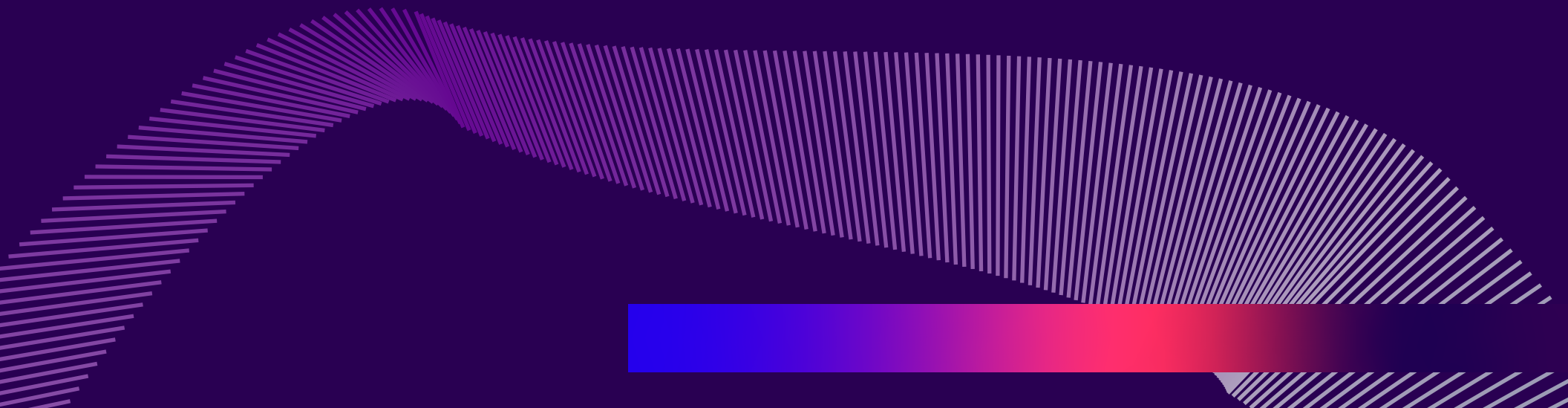
Automatic Data Flow

When is a Digital Twin, not a Digital Twin?

Digital Model: A digital model is a static representation of a physical asset, such as a building or infrastructure component. Typically created using Building Information Modeling (BIM) software, digital models provide visualisation and documentation of an asset's geometry, materials, and specifications. In the construction industry, digital models are valuable for design, coordination, and communication among project stakeholders. However, their functionality is limited beyond visualisation, as they do not incorporate real-time data or enable interactivity.

Digital Shadow: A digital shadow is a dynamic representation of an asset's current state, gathering real-time data from sensors and other sources to monitor and provide insight into its performance. This concept goes beyond a digital model by incorporating live data feeds, enabling a better understanding of how a building or infrastructure functions under actual conditions. In construction, digital shadows can help detect issues, optimise resource allocation, and inform maintenance decisions. However, they do not allow for predictive analytics, or the ability to change the physical asset in real-time.

Digital Twin: A digital twin is an advanced digital replica of a physical asset that combines the visualisation capabilities of a digital model with the real-time data monitoring of a digital shadow. It also incorporates a high level of interactivity, allowing users to simulate various scenarios, perform predictive analytics, and optimise asset performance. By integrating historical data, real-time information, and predictive algorithms, digital twins enable construction professionals to make informed decisions and implement proactive strategies for maintenance, energy efficiency, and resource management.



Identifying Your Use Case and Goals

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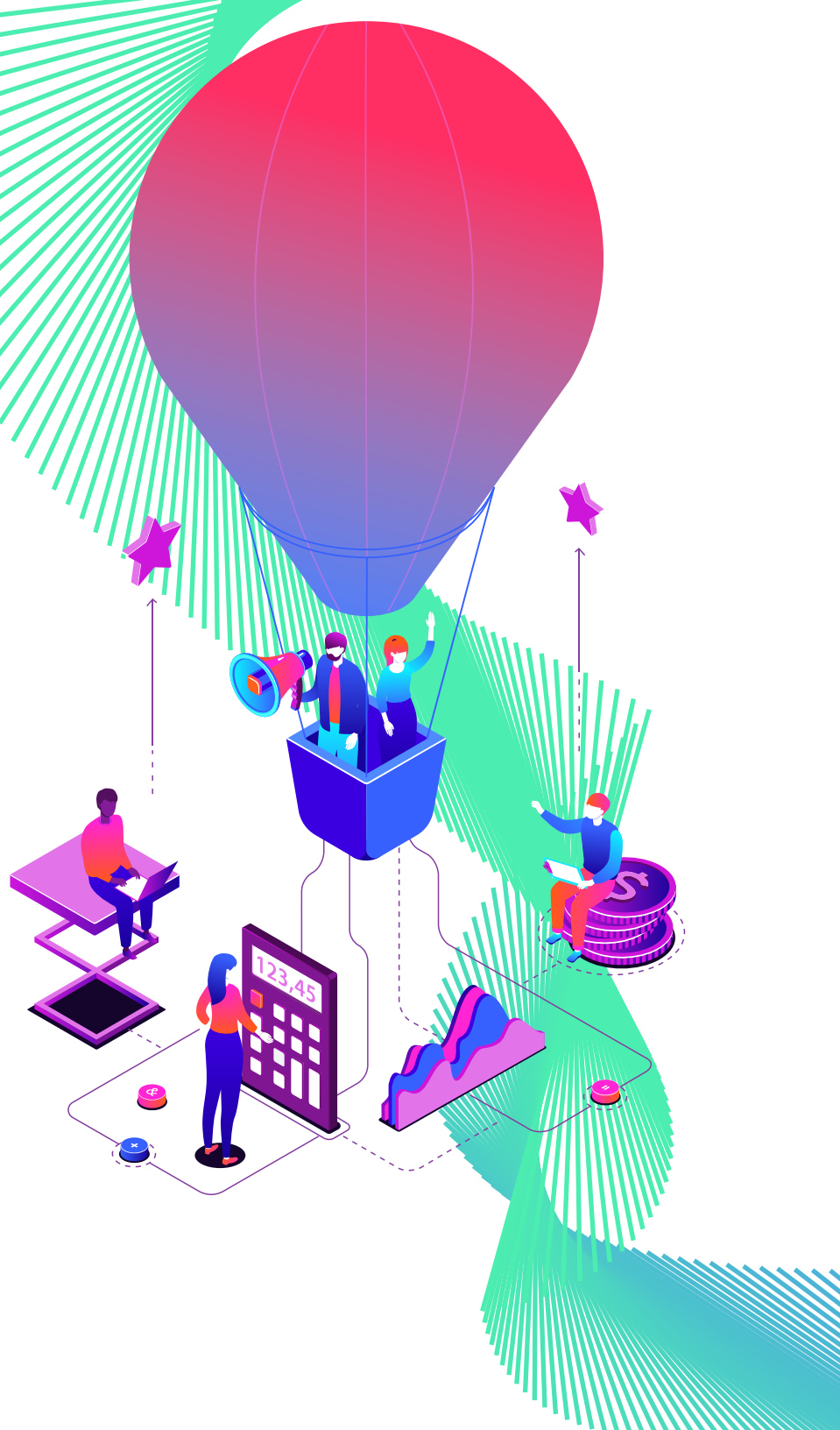
Before implementing a digital twin, it's crucial to identify the specific use cases and objectives you aim to achieve by creating one. Whether you want to be able to manage maintenance from afar, like NASA, improve operational performance like F1 constructors or something totally different it's important you are clear on this ahead of building your strategy.

Some of the most common use cases for digital twins include:

Sustainable Energy Management
By monitoring energy consumption in real-time, digital twins can turn building data into usage patterns while pinpointing inefficiencies. These types of analysis create opportunities for energy savings, like retrofitting lighting systems or optimising HVAC controls. As a result, digital twins contribute to more sustainable energy management practices and reduced operational costs.

Predictive Maintenance and Asset Upgrades
A digital twin monitors the performance of assets and the condition of various systems and equipment continuously. By detecting early signs of wear or malfunction, you can schedule proactive maintenance, preventing costly downtime and extending the lifespan of assets. Additionally, digital twins can help identify areas in need of upgrades, enabling you to prioritise investments that will deliver the most significant impact on asset performance.



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Improving Occupancy Comfort and Space Utilisation
Digital twins can provide insights into environmental factors such as temperature, humidity, and lighting levels, which influence occupant comfort. By analysing this data, you can create "smart" buildings that adjust based on factors like time of day, occupancy levels, and weather conditions, ensuring optimal working or living environments.

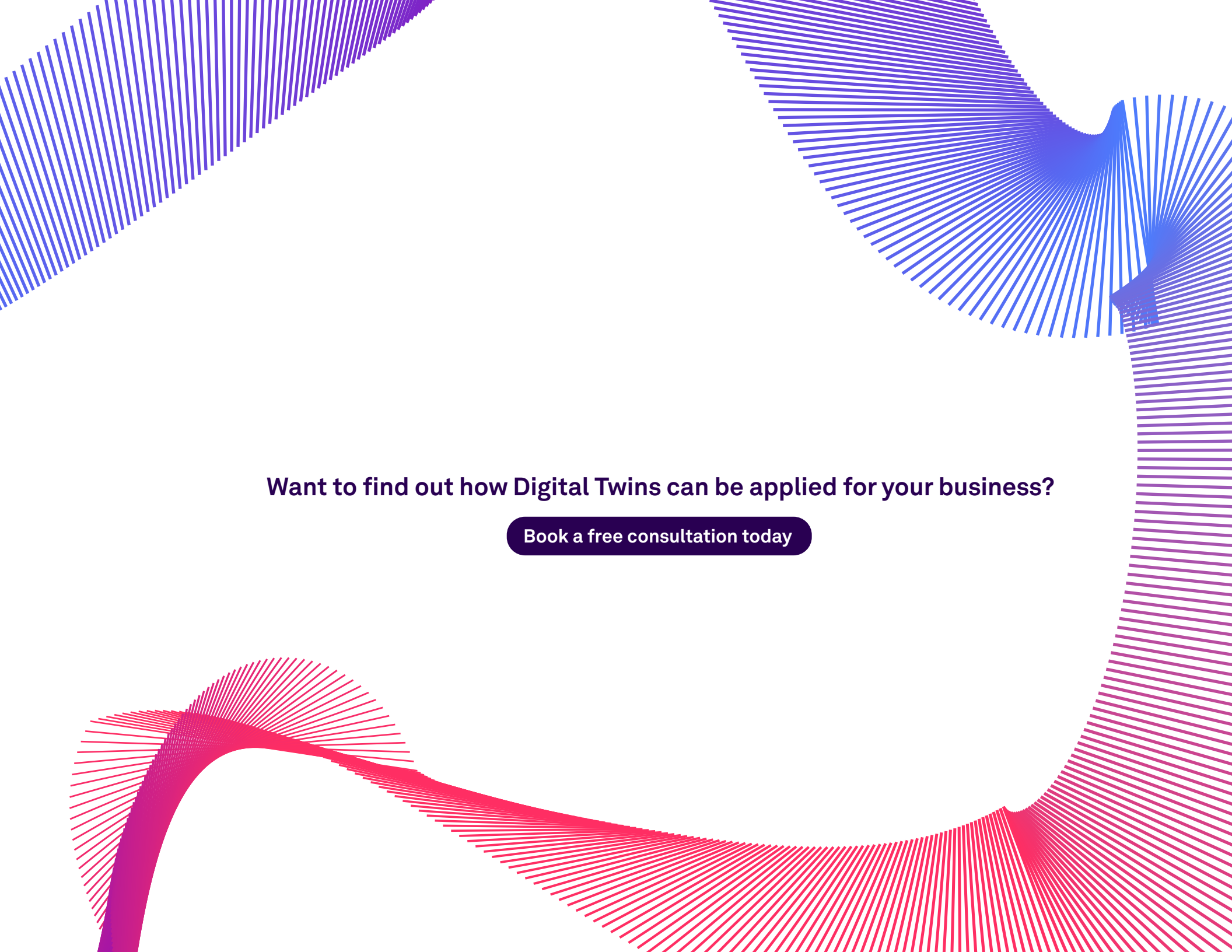
Furthermore, digital twins can help optimise space utilisation by identifying underused areas and suggesting modifications to improve functionality and efficiency.

Create a “Golden Thread” as you build
Digital twins play a crucial role in creating a golden thread throughout the construction process. By creating a virtual replica of the building, digital twins enable the seamless documentation and tracking of essential information, from design and construction to operation and maintenance.

With a digital twin, all parties can easily access and update crucial project information, ensuring that accurate records are maintained throughout the building's lifecycle. This comprehensive data trail is vital for compliance, safety, and future modifications or renovations.

Streamlining Decision-Making and Collaboration
Digital twins facilitate real-time information sharing and collaboration among stakeholders, such as architects, engineers, contractors, and facility managers. By providing a comprehensive view of asset performance, digital twins can help streamline decision-making processes, ensuring that all team members are aligned with project goals and objectives.

The practical applications of digital twin technology in building and asset management are vast and transformative. By leveraging real-time data insights, you can optimise operational efficiencies, reduce costs, and improve the overall performance of your assets.


Want to find out how Digital Twins can be applied for your business?
Book a free consultation today

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