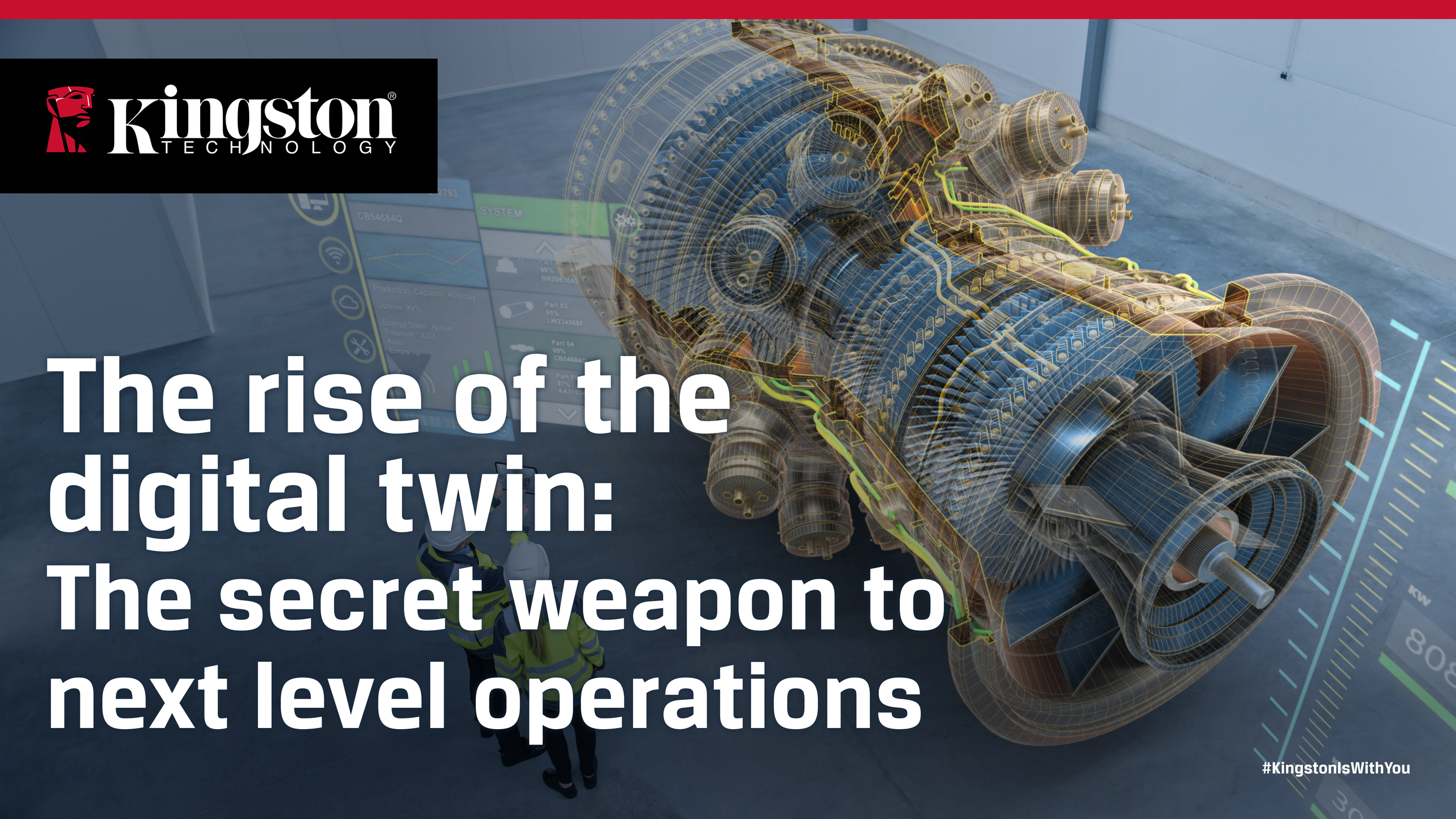

The rise of the digital twin: The secret weapon to next level operations

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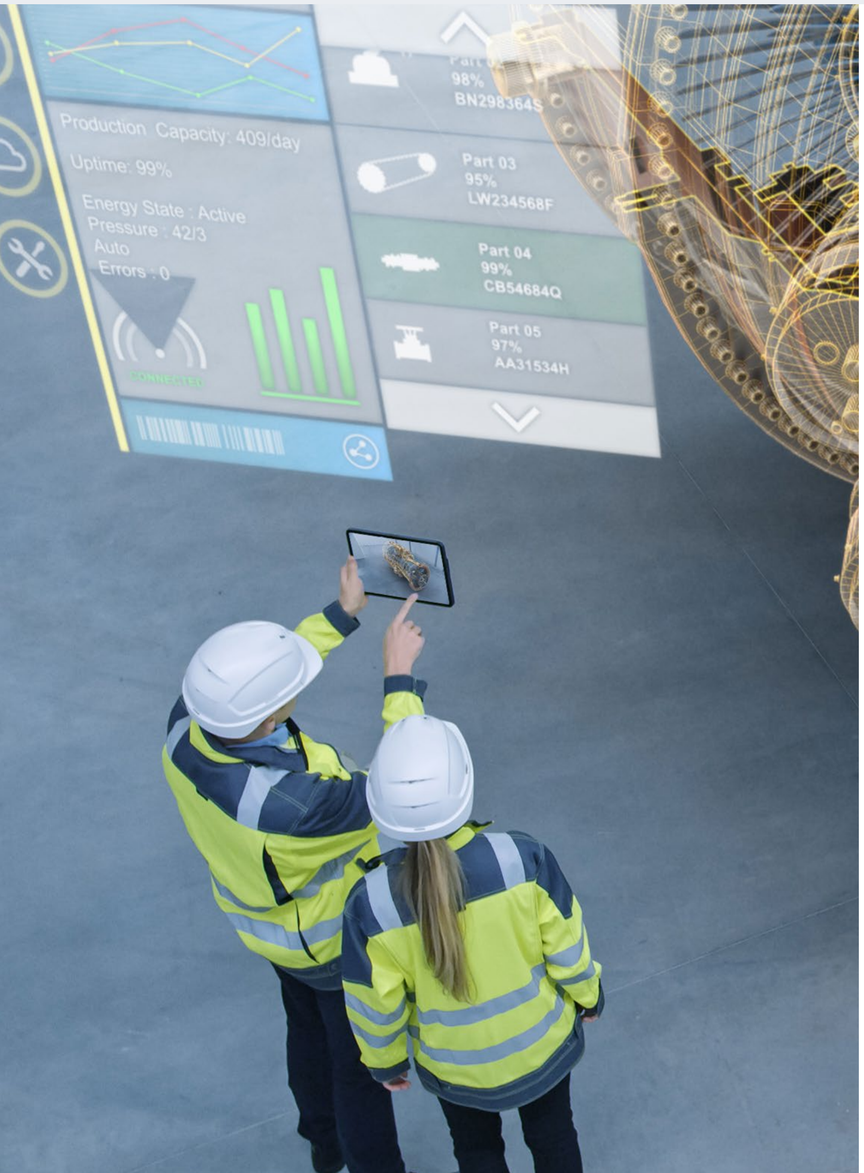


Foreword and contents

The importance of digital twin applications is becoming increasingly recognised by CEOs around the world. In 2021, the global digital twin industry was valued at $6.5 billion, and is projected to reach $125.7 billion[1] by 2030. And with the number of businesses using a digital twin increasing by 40% between 2020 and 2022[2], it's clear that many consider this an emerging technology with the potential to shape the future of their organisation.

But how exactly can a digital twin give your business a competitive edge? What opportunities exist when it comes to enhancing operational capability? And can a digital twin be responsible for replicating success?

This eBook aims to explore the story so far. We'll call on some of the leading industry experts for insights into the tangible benefits, use cases, and thoughts on what the future holds for this complex yet powerful technology.

The rise of the digital twin: The secret weapon to next level operations

Contributors

This eBook has been created by two industry experts in IT and emerging technologies.

Rafael Bloom

Rafael has spent his career within senior Technology Product, Marketing Communications and Business Development roles. His advisory practice focuses on the new organisational, product and communications challenges of technological and regulatory changes. This highly diverse work involves subject matter expertise on information governance and compliance by design, data privacy and emerging technologies such as AdTech, Mobile & 5G, AI and Machine Learning.

Giuliano Liguori

Giuliano Liguori is an open-minded and dynamic global Digital & Innovation Leader with successful results, specialising in leveraging Digital Transformation through the adoption of best strategies and managing techniques. He is currently the CIO of an Italian public sector organisation, Board Member of CIO Club Italia (Italian Association of CIOs and IT Managers), and a Professional Influencer and Brand Ambassador on social media. He collaborates with start-ups, digital agencies, and enterprises around the globe.

Defining the digital twin

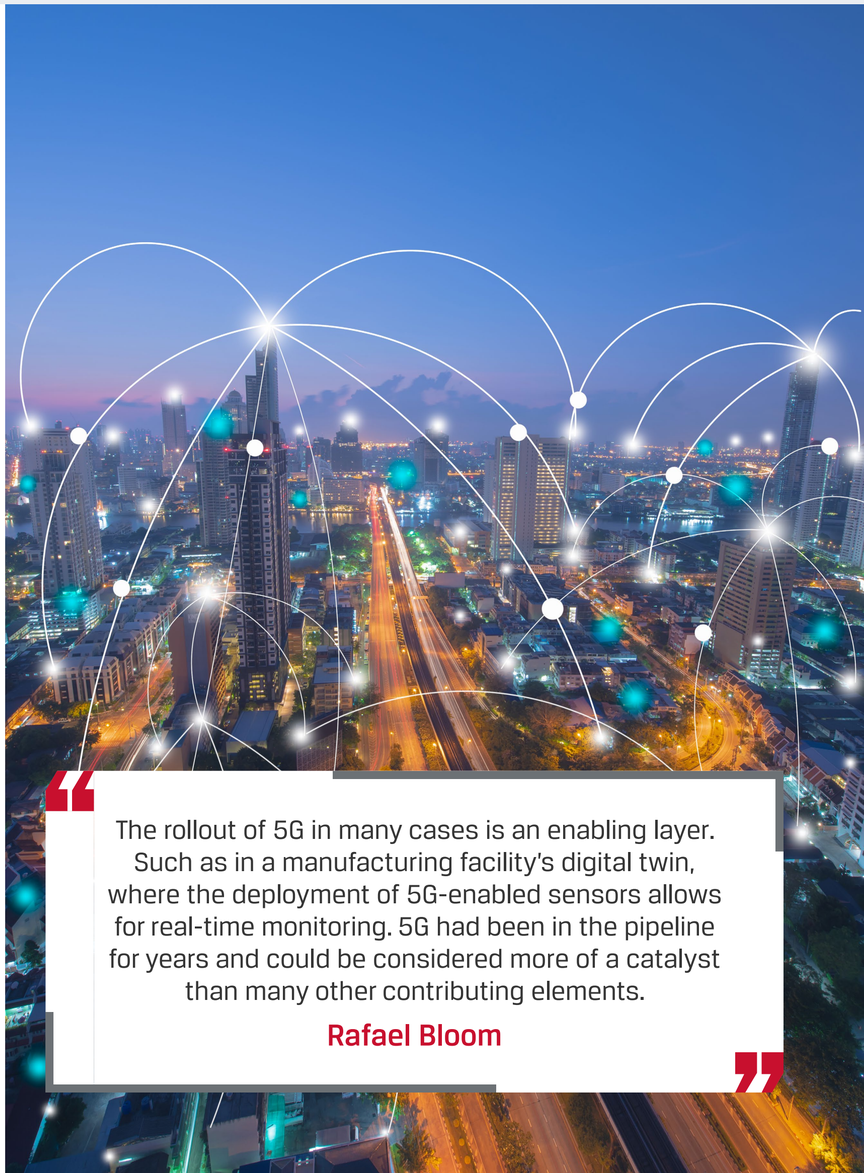
It's fair to say that the pandemic has shaped much of the surfaces by which we interact with technology today. But has it been the catalyst for digital twin adoption? In some cases, this may be true, as organisations have sought new ways to operate remotely and digitally. However, the digital twin has been used in a variety of industries for many years, and the adoption of this technology long predates the COVID-19 pandemic.

Using a digital twin has many uses across industries, offering the ability to provide valuable data on a product's fortitude and functionality – as well as its limitations – all without physically affecting a prototype. When a company's future success demands less waste, shorter times to market, and rich customer insights, the application of digital twins become even more appealing.

That said, while we're hearing the term a lot more, it's still a bit of a buzzword that often lacks clear definition. And without that clarity, knowing how and where to use a digital twin – and, even more importantly, how to drive maximum value that gives you an edge – can be quite the challenge.

Essentially, a digital twin is a digital replica of a physical product, operation, function or system, that can be used for simulation, prediction, and optimisation. It is a computerised representation that acts as a digital counterpart, replicating gathered data about that physical entity. That data can be used to produce simulations and more accurately forecast how a process, or a product will function, and can be generated by several main digital twin archetypes:

- a product twin, which represents a physical product;
- a production plant twin, which could replicate an entire manufacturing facility;
- a procurement and supply chain twin, aka a network twin;
- an infrastructure twin, which can digitally replicate local, or global, assets and processes.

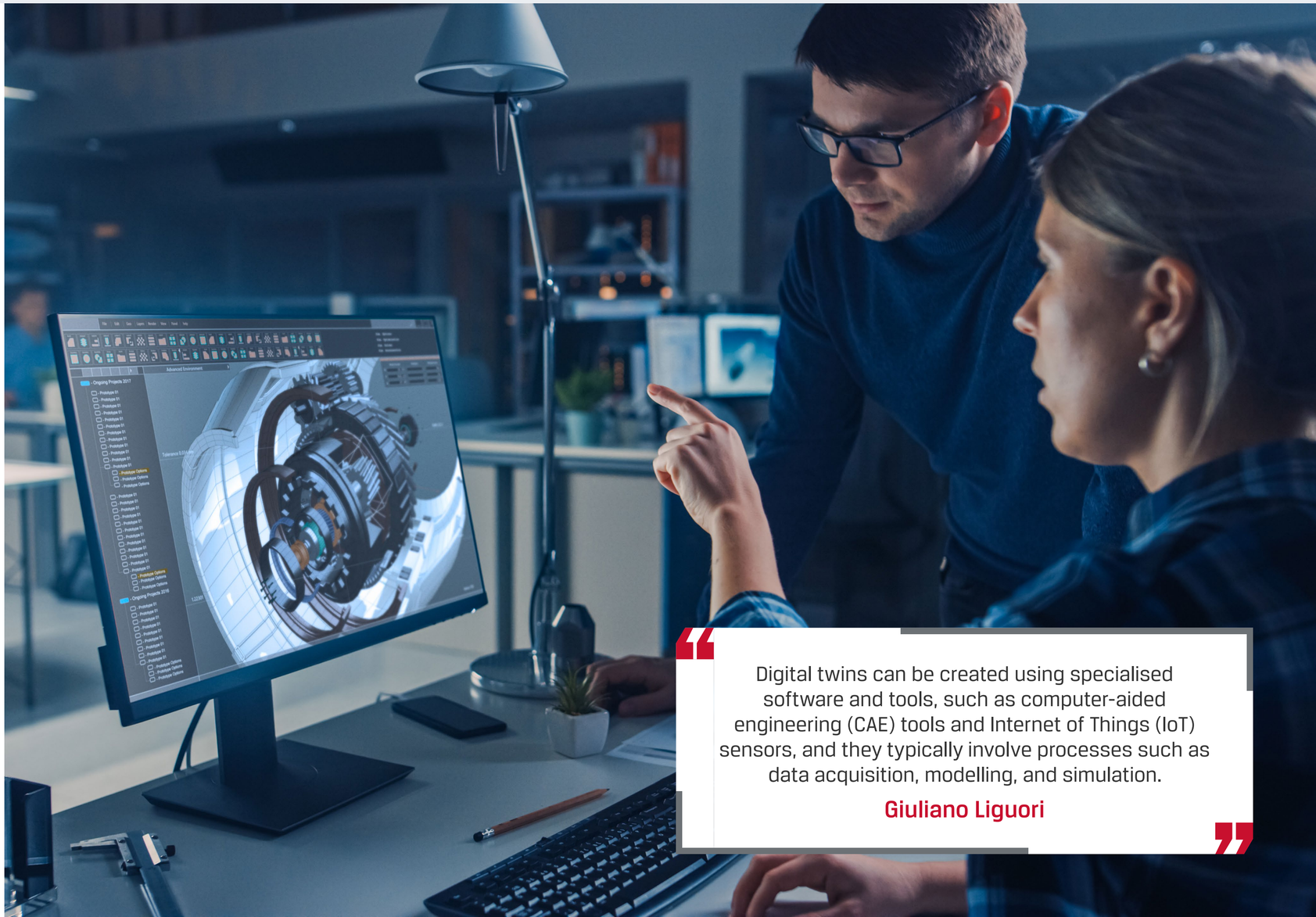


> The rollout of 5G in many cases is an enabling layer. Such as in a manufacturing facility's digital twin, where the deployment of 5G-enabled sensors allows for real-time monitoring. 5G had been in the pipeline for years and could be considered more of a catalyst than many other contributing elements.
>
> **Rafael Bloom**

Defining the digital twin

Another widely acknowledged understanding of a digital twin is the association with computer-aided design, or computer-aided manufacturing (CAD or CAM). While digital twins can be used in conjunction with and derive from CAD/CAM (particularly the type used within the mechanical industry to design components), they are not the same thing.

There are certain distinguishing features that set it apart, such as the connectivity layer that links the physical asset with the digital asset, that was not present in CAD/CAM. Furthermore, CAD/CAM software is used to design and manufacture physical objects, whereas a digital twin is used to virtually replicate and analyse the characteristics and behaviours of physical objects.



> Digital twins can be created using specialised software and tools, such as computer-aided engineering (CAE) tools and Internet of Things (IoT) sensors, and they typically involve processes such as data acquisition, modelling, and simulation.
>
> **Giuliano Liguori**

Combatting global supply chain challenges

Many industry experts agree that current global supply chain issues have allowed digital twin, as a concept, to shine – and that these conditions have helped uncover previously unknown challenges. For example, a digital twin can be used to re-imagine supply chain operations and help organisations better manage their resources. With access to real-time data and simulations, organisations can identify bottlenecks, drive efficiency, and reduce waste. A digital twin can also be used to anticipate and mitigate potential disruptions in the supply chain, such as those caused by the COVID-19 pandemic.

In some cases, the adoption of digital twins in the supply chain may have also uncovered previously unknown challenges, such as the need for improved data management or the integration of new technologies. However, a digital twin is just one of many tools that can be used to address these challenges, and said tools effectiveness will depend on the specific needs and capabilities of the organisation.

At Kingston, we've been developing data center SSDs that keep pace with the demand for new technologies. Taking speed, capacity, and reliability even further, we've added an arsenal of enhanced features for improved stability at extreme speeds, and performance where it's needed most. We help our customers avoid significant cost increases over the coming years, through upgrading their existing IT. So, whether you're looking to roll out a digital twin strategy, 5G, or new AI capabilities, our enterprise-grade SSDs can keep pace with demanding workloads and deliver the longevity and performance you need. Meanwhile, our team offers the skills, technical expertise, and direct support needed to ensure a successful outcome for the long run.

> Yes, there is something in this line of thinking. In order to solve challenges, one needs to have accurate and wide-ranging data to make informed decisions. More data from disparate sources gathered over longer periods of times will inevitably lead to a more complete vision of the truth.
>
> **Giuliano Liguori**

With great detail, comes great storage needs

> Data collection will involve more individual sources, more granular data in terms of its precision, the number of data points and frequency of collection, and it will be shared with more users and other stakeholders.
>
> **Rafael Bloom**

In a 2018 study, IDC predicted that the world would need to store 175 zettabytes (1 ZB = 1 Billion Terabytes) of data by 2025, representing an average growth rate of 27%[3]. We appear to be either on track to reach or exceed that amount, with the acceleration of advancing technologies acting as a major contributing factor. But has there been a significant growth specifically related to the use of digital twins, and if so – what are the key drivers?

Dimensions of data consumption and storage

Let's start by looking at how the dimensions of data consumption and storage can increase when operating in a digital twin environment. A digital twin typically relies on data from various sources, such as sensors, simulations, and historical records, to create a virtual replica of a physical object or system. Key drivers for growth can depend on the specific needs and goals of the organisation, such as how detailed or accurate simulations need to be.

The need to monitor and analyse more data points

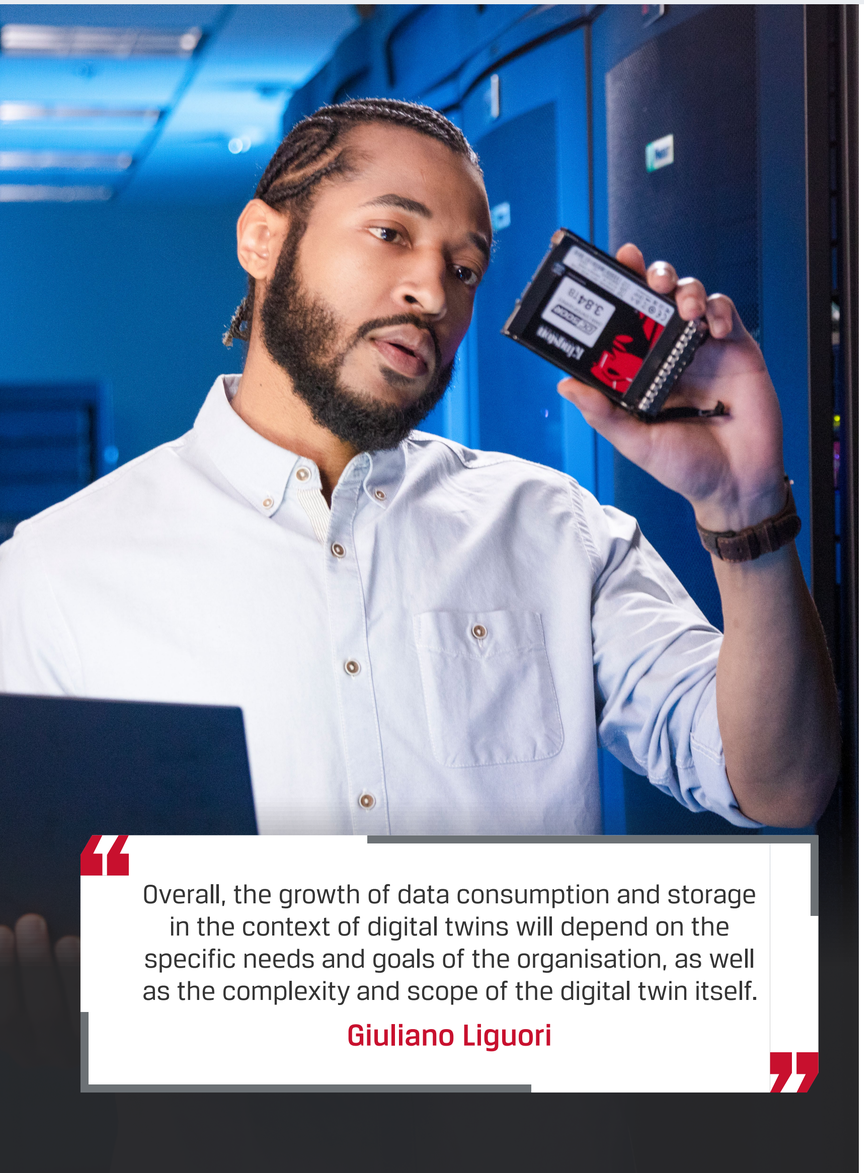
When a digital twin is used to monitor and analyse the performance of physical objects or systems in real-time, the amount of data that is collected and analysed will depend on the number and type of sensors that are used. Naturally, the more data points organisations seek to monitor, the more data they'll consume and need to store.

Storage and analysis of historical data

A digital twin can also be used to analyse historical data to identify trends, patterns, and opportunities for improvement. The amount of historical data that is stored and analysed will depend on the specific needs and goals of the organisation.

So, with this in mind, given the ongoing economic and availability server hardware challenges, how can organisations drive positive digital twin adoption success?

With great detail, comes great storage needs



> Overall, the growth of data consumption and storage in the context of digital twins will depend on the specific needs and goals of the organisation, as well as the complexity and scope of the digital twin itself.
>
> **Giuliano Liguori**

Kingston's Data Center SSDs are one solution range specifically designed for the most demanding workloads. Our products can help organisations manage and instantly access large volumes of data generated by a digital twin, in both traditional databases and Big Data infrastructures.

For memory, Kingston offers some of the fastest DDR4 memory modules available today. Plus, our DDR5 server memory addresses the workload demands of tomorrow. Whichever solution you choose, it must be able to withstand heavy workload activity in scenarios typical for a data center server that requires access to the data for 24 hours of every day in the week.

It's also important to consider the data storage, processing, and communication requirements of a digital twin, as well as any potential constraints or limitations of your existing infrastructure. Here are some key considerations:

1. **Identify a clear business case:** Before embarking on a digital twin project, it's important to identify a clear business case and set specific goals and objectives. This helps ensure the project is aligned with the needs and priorities of the organisation, and that the benefits can be accurately measured.
2. **Start small and scale up:** It's often helpful to start small with a pilot project or proof of concept, to test the feasibility and value of a digital twin in a specific context. This can help identify any challenges or limitations and allow your organisation to refine its approach – before scaling up the use of a digital twin.
3. **Consider data management and governance:** A digital twin relies on data from various sources, and it's important to consider how this will be collected, stored, and protected. Establishing clear data management and governance policies and procedures can help ensure the data used in the digital twin is accurate, reliable, and compliant with relevant regulations.
4. **Engage stakeholders:** Employees, customers, and partners engaged in the development and use of a digital twin can help ensure needs and expectations are aligned. It can additionally contribute to the technology being used in a way that is transparent and accountable.

A cross-vertical solution to boost operational efficiency

From an operational perspective, a digital twin can also be used to remotely monitor and analyse physical systems. This can be particularly useful in situations where it is difficult or unsafe for people to be physically present. Additionally, using a digital twin can help organisations drive operational efficiency and make more informed decisions by providing real-time data and simulations. While digital twins can be used in a variety of industries and sectors, they also have the potential to be applied in a cross-vertical manner, such as:

Construction:

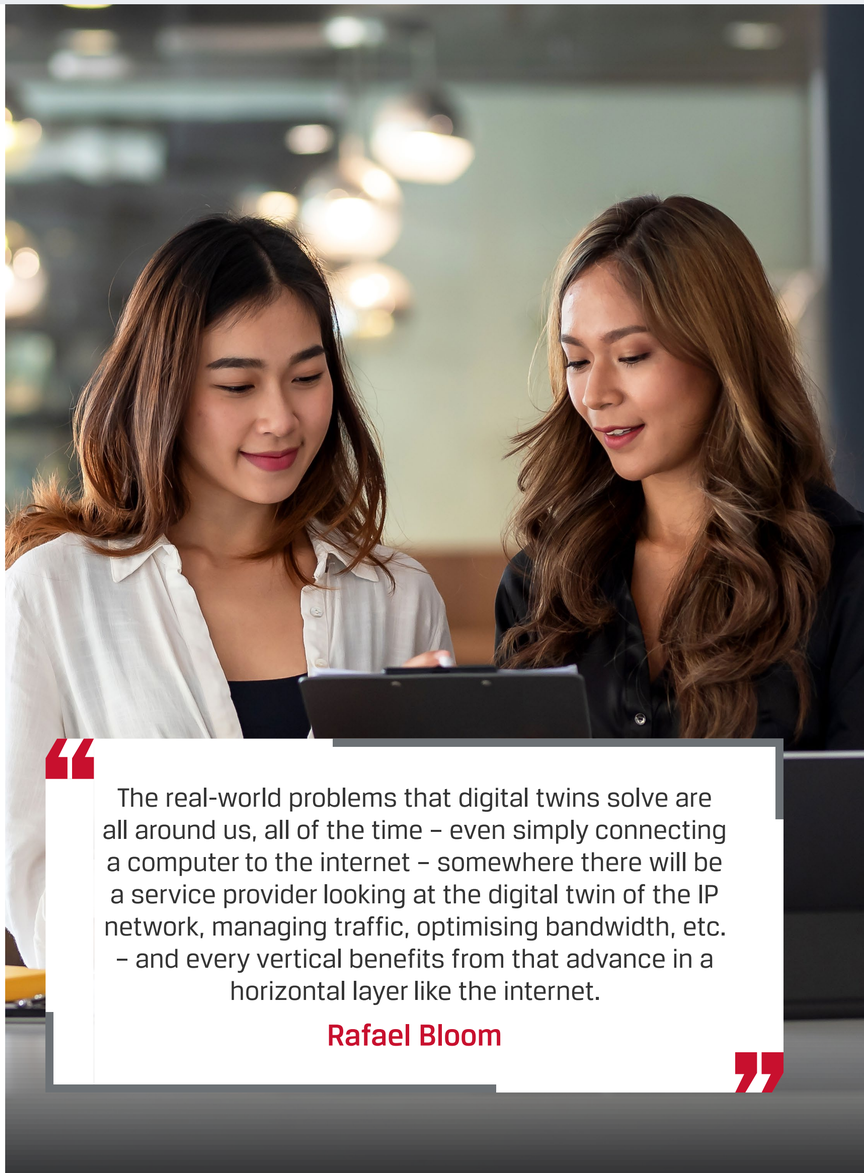
- **Design optimisation and management:** Buildings, infrastructure, and other physical assets
- **Simulation and optimisation:** Flow of people and goods in a building
- **Anticipation and mitigation:** Natural disasters on infrastructure

Retail:

- **Design optimisation and operation:** Physical stores and distribution centres, flow of goods through the supply chain
- **Simulation and optimisation:** Store layout to improve the customer experience
- **Anticipation and mitigation:** Supply chain disruptions

Public sector:

- **Design optimisation and operation:** Public services and infrastructure, such as roads, schools, and hospitals
- **Simulation and optimisation:** Traffic flow on roads
- **Anticipation and mitigation:** Natural disasters on critical infrastructure



> The real-world problems that digital twins solve are all around us, all of the time – even simply connecting a computer to the internet – somewhere there will be a service provider looking at the digital twin of the IP network, managing traffic, optimising bandwidth, etc. – and every vertical benefits from that advance in a horizontal layer like the internet.
>
> **Rafael Bloom**

Optimise, simulate, anticipate: Vertical-specific use cases

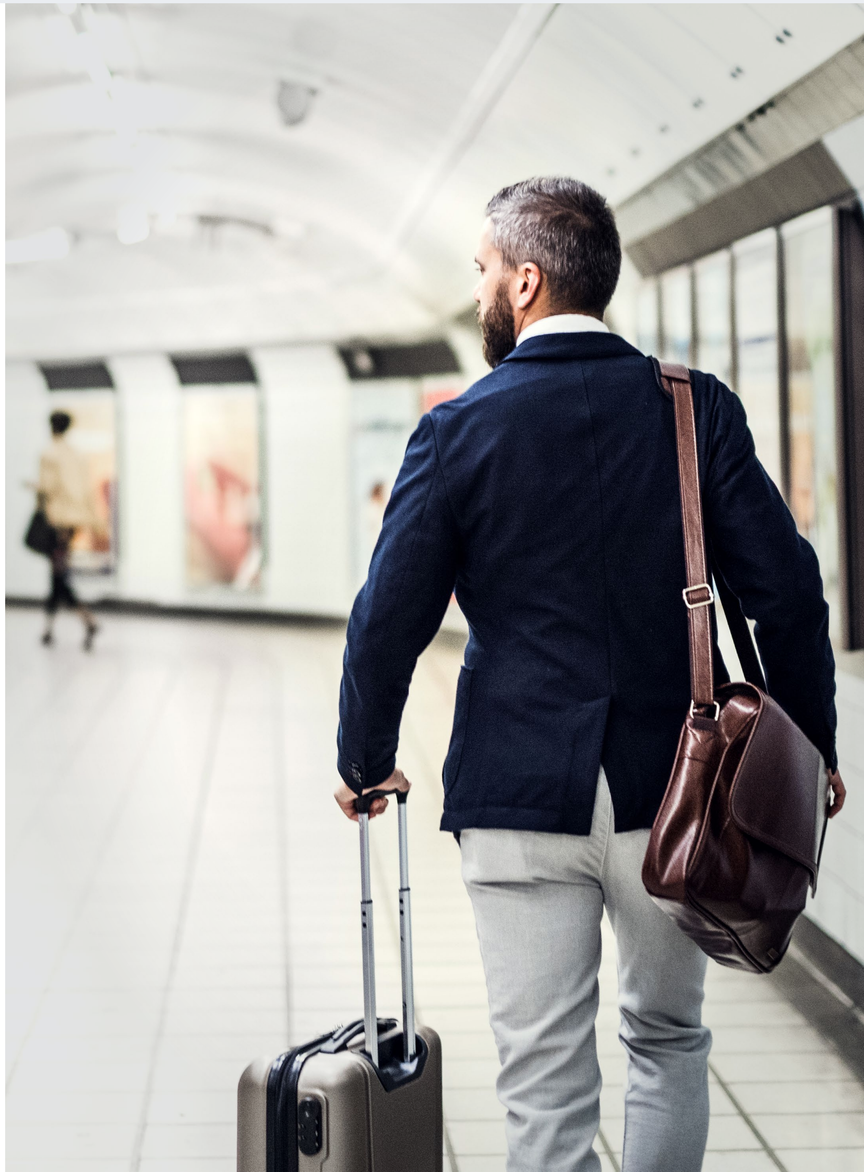
When it comes to vertical specific use cases, there are many examples of how a digital twin can help prevent costly mistakes, provide a clear vision of evolving requirements, and coordinate schedules to ensure on time and on cost project completion.

Let's take civil engineering as one example. Many projects in this sector are launched with spectacular ambition, such as the Crossrail project from Transport for London (TFL) – one of the UK's biggest on-going infrastructure projects. Its £18.7bn Elizabeth Line, made up of 73 route miles and 41 stations[4], used a digital twin to solve the problem of siloed teams and data.

This comprised over 250,000 models[4] including everything from lightbulbs to cable trays, each one "twinned" and labelled from database information on Crossrail's physical assets. The 3D model form gave Crossrail managers the ability to monitor the Elizabeth Line on various devices, once construction work began. To advance such a far-reaching project (with its own budget challenges), the use of digital twin technology has enabled the ability to gain efficiencies.

Not only did this result in stakeholder time and money savings, it meant that Crossrail workers could hold up a tablet for an augmented reality (AR) view of communications, water, and electricity. This could be done beneath any station wall or floor – removing all need for maps and potentially outdated models.

> In a civil engineering project like that, so many different stakeholders must cooperate that a single view of the truth is essential in order to be precise in engineering terms, to achieve logistical coordination, and to anticipate and collate factors from multiple sources that might affect hundreds of deliverables and subtasks.
>
> **Giuliano Liguori**



Optimise, simulate, anticipate: Vertical-specific use cases

From a manufacturing perspective, recent research shows digital twin use can drive revenue by up to 10%, accelerate time to market by as much as 50%, and improve product quality by up to 25%[5]. Another significant use case impacted by digital twin technology is the operation and management of smart cities.

With such significant value propositions within the build environment, this technology has the potential to cut project and building costs by up to 35%. The sustainable business case is another strong angle, with recent research reporting that digital twins can help track and reduce between 50% and 100% of carbon emissions, in support of a clean energy transition[6].

Let's look at some other key vertical-specific applications:

Manufacturing:

- **Design optimisation and operation:** Factories, production lines, and other manufacturing systems
- **Simulation and optimisation:** Flow of materials and products through a factory
- **Anticipation and mitigation:** Potential malfunctions and crashes of machineries

Energy:

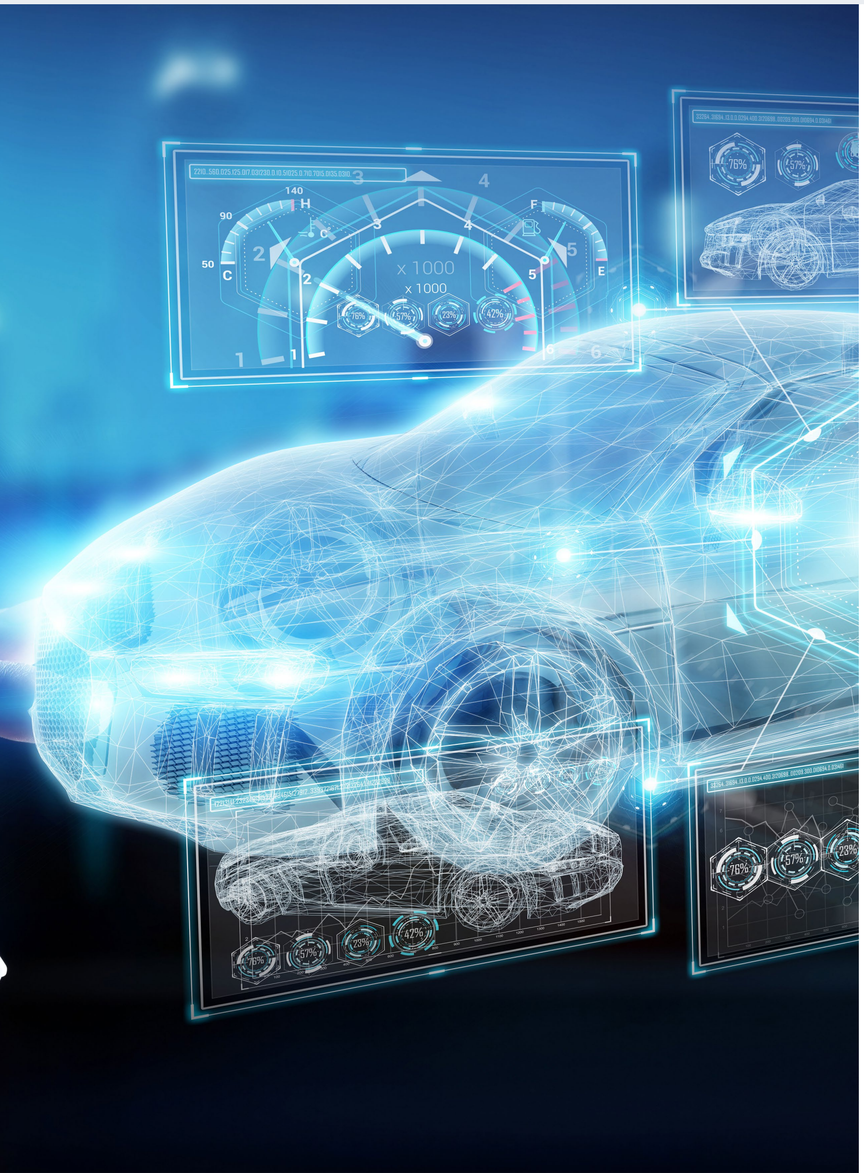
- **Design optimisation and operation:** Power plants, wind farms, and other energy assets
- **Simulation and optimisation:** Energy flow through a power grid
- **Anticipation and mitigation:** Breakdowns and their consequences

Healthcare:

- **Design optimisation and operation:** Delivery of care, cost reduction, and patient outcomes
- **Simulation and optimisation:** Treatment of complex medical conditions, such as cancer and heart disease
- **Anticipation and mitigation:** Equipment failures

> Digital twins can be also used to optimise the operation and maintenance of water infrastructure, such as reservoirs, pipes, and treatment plants. Aside from smart cities, Manufacturing, Energy, Healthcare, and Transportation are undoubtedly areas where Digital Twins can make a significant impact.
>
> **Giuliano Liguori**

The future of digital twins: Improved integration, wider industry adoption



> Overall, the future of digital twins is likely to be driven by advances in technology and the evolving needs of organisations. As the technology continues to evolve, it is likely that we will see even more innovative and diverse applications of digital twins in the future.
>
> **Giuliano Liguori**

While technology is continuously evolving and the potential applications are numerous, it's hard to predict the future for digital twins. However, it is likely that adoption will continue across a wider range of industries and organisations, as the technology becomes more sophisticated and accessible.

What we do know is that the infrastructure to support digital twins exists, the layers of connectivity have been established in a manner flexible enough to be adaptable, and the presence of digital is ubiquitous. Organisations should still however invest in research to resolve the associated data storage and consumption challenges, and find products that are best suited to support their business goals.

This is where Kingston can help. Our proven experience, recognised best practices, and trusted industry leadership make our products the smart choice for advancing technology such as digital twins. From large capacity to stunning endurance, overall performance to unmatched data protection, our memory and storage solutions deliver what's needed to support complex technology initiatives. Meanwhile, our expert team offers the knowledge and resources you need to choose memory and storage solutions with confidence.

> Of course, there is more innovation to come but this is a factor of external change and evolution as well – new solutions emerge in response to novel problems.
>
> **Rafael Bloom**

Summary

There's no doubt that the use of digital twins has expanded beyond its original intended usage of manufacturing and engine design. And that across industries, companies are now able to forecast and create with greater accuracy and foresight than ever before.

Used correctly, digital twins could mark a new stage for many organisations, but to what extent and how this technology evolves remains to be seen.

1. **Allied Market Research**
   https://www.alliedmarketresearch.com/digital-twin-market-A17185
2. **Strategic Market Research**
   https://www.strategicmarketresearch.com/market-report/digital-twin-market
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5. **McKinsey**
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6. **Fast Company ME**
   https://fastcompanyme.com/technology/why-does-a-smart-city-need-a-digital-twin/

About Kingston

With over 35 years of experience, Kingston has the knowledge, agility, and longevity to enable both data centers and enterprises to respond to the challenges and opportunities presented by the emergence of digital twins, AI, 5G, IoT and edge computing.

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