WHY DIGITAL TWINS ARE CRITICAL TO THE INDUSTRIAL IOT

Whitepaper

JUNIPER RESEARCH

1.1 Introduction to Digital Twins

The concept of a Digital Twin has become highly important in the industrial world, as stakeholders throughout the industrial ecosystem seek to harness technology to increase efficiency. Digital Twins are essential elements of IIoT (Industrial Internet of Things) platforms and are increasingly being offered by a range of vendors.

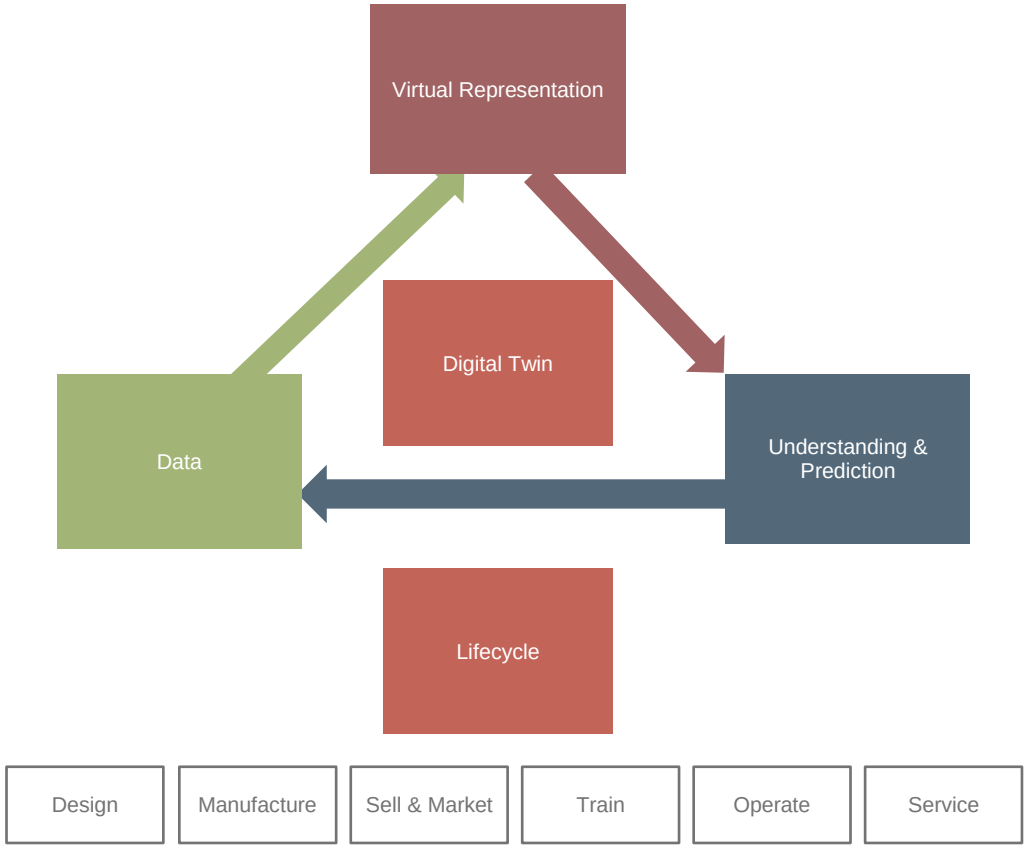
Juniper Research defines a Digital Twin as:

A virtual model representation of a connected physical product, process, or service, across its whole lifecycle (design, build, operate). The virtual replica uses operational real-time data and other sources of information to enable detection of issues, advance both learning and understanding, as well as test and simulate scenarios in the physical model counterpart.

Examples of these virtual, connected objects/products include connected cars, airplane turbines, smart cities, and buildings. The objects are usually first created and modelled via a software modelling programme such as CAD (Computer-Aided-Design), that is used by engineers in the early stages of product development.

Technology innovations, such as Big Data analysis, machine learning, AI, software analytics and cloud solutions, as well as the growing demand for sensors to capture and process data, have been significant drivers for the adoption of Digital Twins over the last few years. Figure 1 outlines the major elements of a Digital Twin model.

Figure 1: Main Components of a Digital Twin Model



Source: Juniper Research

Digital Twins modelling in the IoT (Internet of Things) operations has produced a range of advantages for several industries as follows:

- Visual communication of crucial information and data about products and/or services in complicated operational environments and in context; such as rate of manufacturing efficiency or supply chain functioning, and detection of potential machine production errors.
- Forecasts of realistic, likely scenarios of emerging errors and/or inefficiencies in the connected physical object thanks to its live link and tracking between the virtual and physical realms.
- Analysis of data and systems' monitoring to head off problems before they even occur, prevent downtime, develop new opportunities and even plan using simulation.
- Integration with, and utilisation of, digital innovations such as machine learning, HPC (High-Power Computing), artificial software, edge processing, blockchain and analytics to facilitate effective process automation, intelligent business decision-making, rapid responses to queries and increased production efficiency.

In recent years technology advances, particularly Big Data and cloud computing, have enhanced the significance of data and information analytics in Digital Twins models to help industrialised businesses gain in-depth insight on issues hampering the efficiency of their operations.

1.2 The Value of Using Digital Twins in IoT

Digital Twins were originally used parallel to information primarily provided by R&D organisations to model and analyse data. Manufacturing was one of the first industries to understand the value of using Digital Twins for product design, simulation and construction of virtual 3D models to optimise processes and/or a product's lifecycle.

Three main conditions have led to the rise of Digital Twins in manufacturing:

- Traditional manufacturers have operated physical and virtual models of their environments but have been challenged to ensure crucial details of processing and data flow match each model simultaneously in real-time. This, in turn, has usually made end-to-end visibility of their product's lifecycle poor.
- The need to marry physical and virtual ecosystems live (in real-time) to model changes to complicated systems that involve software, hardware and digital representations of machines.

Digital Twins help to address these three main challenges by leveraging HPC, IoT, AI, PLM (Product Lifecycle Management), ERP (Enterprise resource planning), Predictive Engineering Analytics and mixed reality technologies to maximise real-time efficiency in both equipment use and the entire manufacturing process.

1.3 Key Factors Driving Digital Twins Adoption

A range of developments in the last few years has driven, and continues to fuel, the adoption of Digital Twins, including:

- The velocity at which data is being gathered via IIoT platforms, sensors and machines, and high-speed connected networks, that has enabled the acquisition of large amounts of real-time data.

- The quality, in addition to the large amounts of data at a detailed level, that is acquired, processed, and stored. This trend will be enhanced over time, with its value being able to paint an accurate, transparent picture of the physical assets (such as devices, hardware and physical systems).
- The rise of AI which, if leveraged correctly, can allow systems to learn from collated data. Digital Twins can interpret the collected data and help engineers to calibrate the model to reflect real-world scenarios, if utilised in the correct way.
- Edge intelligence in IoT systems has allowed products/service to act independently, rather than fully relying on connectivity to capture data and information. Edge processing is also a key pillar of many IIoT systems, so the confluence of edge and Digital Twins will be highly important.

1.4 Challenges to Digital Twins Implementation

Initially, implementing Digital Twins was expensive and complex to do, given that a range of effectively functioning parts of an IIoT platform had to be in place. Therefore, as the implementation of an IIoT system is necessary to the use of a Digital Twin, this has limited progress to larger organisations which have already embraced the benefits of the IIoT. As a result, market leaders in industries such as manufacturing and utilities were the first to deploy Digital Twins simulations.

Organisations wishing to reap the benefits of implementing Digital Twins must consider the following challenges. It is also worth noting that many of these challenges are not unique to Digital Twins; they also apply to many implementation efforts for IoT platforms:

- Engineering Analytics: Managing data to assess future risks in a company's operations may be a troublesome, complex process. However, advanced technologies such as machine learning, cloud and both software and engineering analytics, are increasingly being used by many industries, from transport to manufacturing to energy, to address this problem. The challenge will be in accessing these analytical insights. Either companies implementing this will need to leverage their own data science expertise, which can be difficult to source, or rely on outside experts.
- Offline/Online Data: For data that is critical, such as measuring production of harmful emissions for factories in real-time, it is important for sensors capturing such information to be constantly online. For other scenarios, such as an aircraft in flight, offline sensors can capture and store data on the performance, for example, of the aircraft's turbines. For the connected car, edge processing enables data to be collated even when mobile connectivity to the car is broken, due to the vehicle passing through a tunnel, for example.
- Data Security: Organisations wishing to employ Digital Twins models must trust the security measures offered by the IIoT platform provider. This can be a challenge when the application of Digital Twins is in a sensitive area, such as power. However, in most cases, if the use of Digital Twins is not sensitive from a security point of view, but it will be from a commercial point of view.

1.5 Market Forecast Summary: Digital Twins Revenues in 2020

Total global spend on Digital Twins will reach $12.7 billion by 2021, an increase of 17% from $10.8 billion in 2019. Digital Twins are a digital representation of physical assets which utilise IoT data, enabling use cases such as predictive maintenance when combined with AI.

- Despite the negative impact of COVID-19, we only anticipate a 1% drop in overall Digital Twins spend in 2020. Investment in Digital Twins is driven by valuable efficiency gains, which are increasingly essential in uncertain times. Under these circumstances, return on investment is still achievable, primarily due to the extensive links Digital Twins have to the wider IoT ecosystem.
- Digital Twins are not generally standalone products and must be implemented as part of a wider Industrial IoT strategy. While IoT sensors generate enormous amounts of data in the industrial setting, interpreting this data and putting it into operation requires a collaborative approach based on open platforms.
- Manufacturing will be the single biggest sector for Digital Twins deployment, accounting for 34% of total spend in 2021, followed by energy and utilities at 18%. North America will dominate spend, accounting for 67% of manufacturing spend in 2021. The US has had successful partnerships in the IoT ecosystem driving adoption, which is an approach that should be replicated in other markets.

Figure 2: Total Digital Twin Revenues, Split by Sector ($bn), 2021: $12.7 Billion

Source: Juniper Research

Order the Full Research

Digital Twins in IoT's latest research provides an in-depth assessment of the origin, challenges, advantages, key drivers and future outlook for Digital Twin trends, particularly in the wider Industrial IoT. Featuring a comprehensive comparison of 15 vendors including an expanded Leaderboard, it has a detailed evaluation of select key players and industries that offer and utilise Digital Twins solutions to boost efficiency and add value.

This Digital Twins research provides crucial insights for multiple industries, particularly in manufacturing, transport and energy and utilities, seeking to deepen their understanding of the different strengths, opportunities and weaknesses of Digital Twin modelling solutions. It explores key markets championing the use of Digital Twins, and subsequently driving adoption of the technology, to enhance the efficiency of their physical assets and processes. It also examines best practice deployments to highlight innovative solutions.

Key Features

- **Market Dynamics:** Strategic analysis of the major drivers and innovations shaping the adoption and development of Digital Twins including enhancing the value of Digital Twins through technological innovation and the future strategic direction and market outlook for Digital Twins
- **Sector Challenges:** In-depth assessment of the key challenges to further Digital Twins deployments and how to overcome these difficulties.
- **Juniper Research Leaderboard:** 15 players offering Digital Twins compared, scored and positioned on the Juniper Research Leaderboard, including General Electric, Microsoft and Siemens.
- **Benchmark Industry Forecasts:** Key forecasts for the size and growth of the market, including: Digital Twin Revenue, Split by Manufacturing, Energy & Utilities, and Others; Number of Industrial Companies Deploying Digital Twins; Number of Manufacturing Companies Using Digital Twins; Number of Energy & Utility Companies Deploying Digital Twins.

What's in This Research?

- **Market Trends & Opportunities:** Strategic analysis of key players offering Digital Twins, together with a detailed investigation of their strengths, limitations and strategic opportunities through the Juniper Research Leaderboard. (PDF)
- **Strategic Analysis:** In-depth assessment of key drivers contributing to both present and future adoption of Digital Twins in a variety of sectors, markets and regions; it also explores future strategic opportunities in the Digital Twins sector. (PDF).
- **IFxl (Interactive Forecast Excel):** Highly granular dataset comprising over 700 datapoints, allied to regional and sector analysis tools giving user the ability to manipulate Juniper Research's data.
- **harvest Digital Markets Intelligence Centre**: Visualises all the data in easy to use and exportable graphs, tables and charts, and features continuous data updates for 12 months.

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