

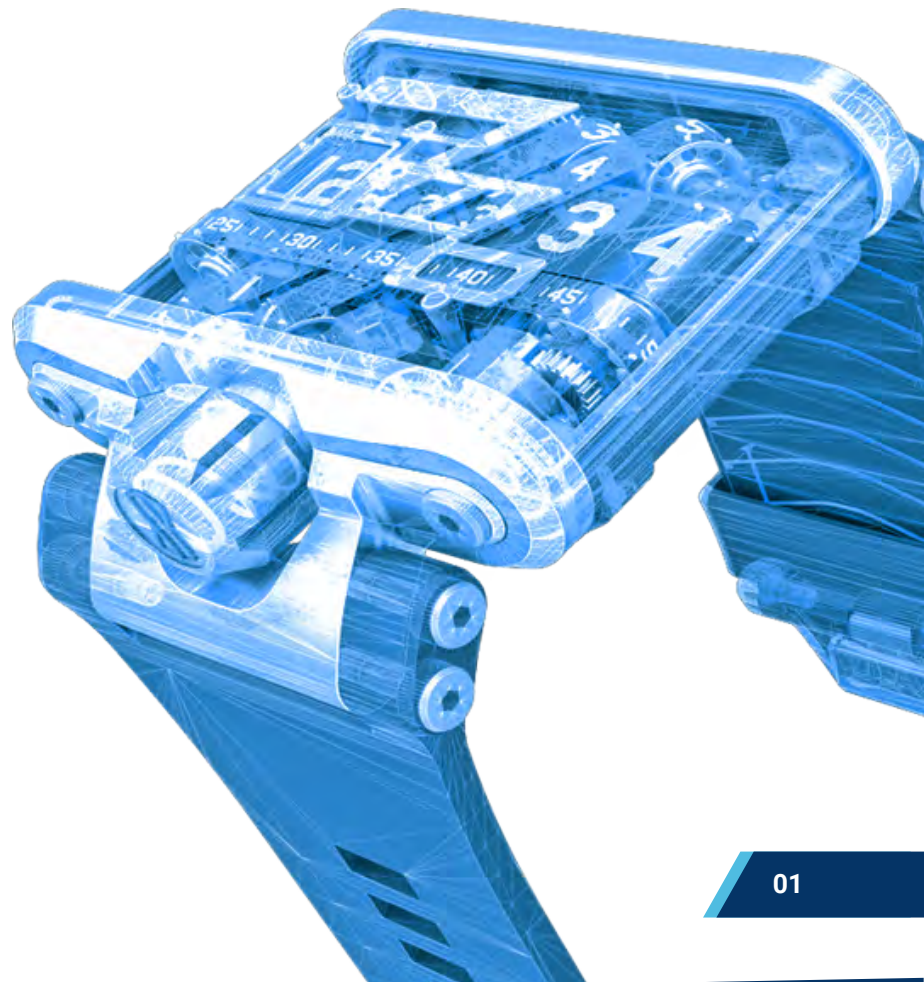


Digital Twins | Whitepaper

THE RISE OF DIGITAL TWINS **IN INDUSTRY 4.0 & IIoT**

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INTRODUCTION

Disruptive technology has been prevalent since the turn of the century, due to the recent success of growth in areas of IoT, artificial intelligence, big data and machine learning. As industries become increasingly digital, the trend of digital twins is one that appears to remain.

Digital twins are a near-real-time digital image of a physical object or process that will help business performance. Digital twins are born through the synthesization of a number of sources, such as operational, physical, and manufacturing data and insights from analytics. Once integrated with algorithms of artificial intelligence - we have a virtual product that we can modify and analyze.

Digital twins gives companies the ability and security to have a digital footprint on their products, protecting the commodity from end-to-end. In recent years, digital twins have become more accessible, due to its significantly lower costs and improved power and capabilities. This has led to exponential changes, allowing industry leaders to combine information and operations technology to enable the creation and use of a digital twin.

As digital twins are relatively new, it can be quite intimidating for business adoption. Enterprise must first understand entirely the meaning and approach of digital twin development. In this document, we discuss digital twins - its definition, creation and importance. The ways that digital twins can drive value, its applications in the real world, and how a company can prepare for the digital twin planning process will also be dissected.

THE IMPORTANCE OF DIGITAL TWINS

Digital twin technology continues to infiltrate extensive industries, but what exactly is it and why is it so important?

Digital twins, in its simplest form, is a digital representation of a physical object or system. The digital twin replica of the process or system can be used for many purposes, such as the integration of artificial intelligence, software analytics and machine learning with data to create living digital simulation models. The twin is based on cumulative, real-world data measurements, creating and expanding profiles of the object that could provide important insights on system performance.

These digital simulations will automatically alter as their physical twins change, affecting the design, build and operation of how products form. Digital twins can continuously learn and update from multiple sources, to represent its real-time status.

The true power of the digital twin underlies in the linkage between physical and digital worlds. The interaction between real and digital promises to bring an aspect of certainty to the unpredictable. The opportunity of interaction with the digital will provide measurements that can be analysed for predictive feedback and offline analysis - a practice that would have previously been unattainable.

Manufacturing application of digital twins

Digital twins are utilised to model intricate assets and processes that interact with their environment in unpredictable ways. Digital twins can simulate assets such as ships and jet engines, to monitor its functionality and detect possible faults. These insights are pivotal as it could affect future product design. A digital twin of an aircraft may expose insights into its operational inefficiencies.

The process of manufacturing could perhaps benefit from digital twins the most. The digital twin could become a replica of real-time process of the factory floor. The data that is captured, from measurements to the behavioural aspects, will be communicated and aggregated by the application of digital twins.

As the digital twin is constantly analysing the continuous stream of data, it may uncover unacceptable trends that could trigger investigation and change aspects of the manufacturing process in the physical world.

Below are a some impactful ways smart manufacturers are leveraging digital twins to achieve a model-based enterprise:

1. Engineering

Within manufacturing, digital twins can actually exist before its physical counterpart as opposed to creating a digital representation to enhance the product. Internet of Things now provides the possibility to capture data from the products utilised on field to be applied for continuous product improvement.

2. Design

Digital twins will make it possible to easily demonstrate potential design modifications in digital form. This will be extremely beneficial in a time where consumers continue to demand customised products. Consumers are looking for flexibility, and digital twins will make it easier to meet their demands and enable manufacturers to generate a fuller picture of customer demand trends and product performance.

3. Production

Digital twins provide the capability to compare quality data across multiple products. Providing deeper insight to quality issues will allow the manufacturer to visualise any issue that may arise. Manufacturers now have the ability to analyse and visualise data immediately.

4. Operations

The enhancement of operations is one of the most beneficial applications for digital twins. Manufacturers will be able to oversee the entire operations process, capturing data from embedded smart sensors and providing a clearer picture of real-world operations. It will also be possible to simulate a real-world environment for predictive maintenance.

CREATING A TWIN

The creation of a digital twin begins with the product design.

Product design techniques are used to show how business processes and applications interact with information and physical assets. The creation of diagrams will link the process flow to the need for data, applications, and the types of sensor information needed to create a digital twin.

The process design will consider cost, time and asset efficiency, forming the start of where digital enhancements should begin.

Digital twin architecture

The conceptual architecture is best understood from a six step sequence.

Create

The creation step incorporates the supply of sensors in the physical process that measure crucial inputs from the physical process and its surroundings. The measurements by the sensors can be classified as operational measurements, such as colour, movement and strength, or environmental data that affects physical asset operations, such as temperature or moisture levels.

Communicate

Communication aids the smooth and continuous integration between digital and physical assets. Network communication is a change that has enabled digital twins, and consists of three components - communication interface, edge security and edge processing.

Aggregate

Aggregation supports the ingestion of data into a repository, to be processed and prepared for analytics. It can be accomplished on the premise, or also in the cloud. Technology that powers data aggregation have revolutionised within the last few years, allowing designers to create and scale architectures with increased swiftness and at a decreased cost.

Analyse

Data needs to be both analysed and visualised. Data scientists can use analytics to create models that can provide insight to aid decision making.

Insight

The insights obtained from the analytics are presented through visualisations, which highlight acceptable differences in the performance in the digital and real world model, indicating areas that could need investigation or change.

Act

Actionable insights from the previous steps should be fed back to the physical asset and digital process to impact the digital twin. This interaction closes the loop connection between the physical world and digital twin.



DRIVING BUSINESS WITH DIGITAL TWINS

Although companies are beginning to realise the significant value of digital twins within business, a concern that has been raised by those beginning to embrace digitisation is whether the benefits outweigh the investment in creation.

Businesses should consider the value that digital twins offer to issues of strategic performance and marketplace. Business value from the digital twin has been driven from speed of production, to the improved operations and reduced defects of the product itself. Digital twins are enabling companies to solve physical issues efficiently by early detection. This will ultimately lead to increased sales and satisfied customers.

Conclusively, digital twins will offer the opportunity to drive value and change how a company fundamentally does business. Digital twins could be crucial in addressing many other key performance and efficiency metrics for industries such as manufacturing.

How Can Digital Twins Benefit Your Enterprise?

Enable data-driven decisions

The construction of a digital representation provides an accurate perspective of how your devices operate in real time. The data gathered from this will enable companies to make better decisions. For example, if the equipment is lagging in manufacturing, it is possible to upgrade or repair the machinery before it impacts business efficiency.

Automated processes

Digital twins provide the connectivity needed to better the business process. By combining real-time data gathered with previous historical data and machine learning capabilities, the digital twin allows enterprise to predict problems and solve them automatically. Digital twins can anticipate issues and prevent them before they occur, avoiding service interruption or increased downtime.

Collaboration boost

Creating a network for digital twins makes sharing data with colleagues, supply chain partners and customers more accessible. With this insight, partners and customers can collaborate with your business to improve the processes and the products.

Areas such as R&D, finance, sales and marketing benefit from increased visibility, allowing everyone to be on the same page to ensure that the product is properly designed and commercially viable. By monitoring customer interaction with products, businesses can remove redundant features and develop higher quality products.

New business models

Digital twins will make adaption to industry-altering disruption easier, providing the opportunity to regenerate existing business models and generate increased revenue. Exploring innovative business models is a simple way to remain profitable during an age of digital transformation.

WHERE TO START

With the abundance of information on digital twins - where do you begin with its application?

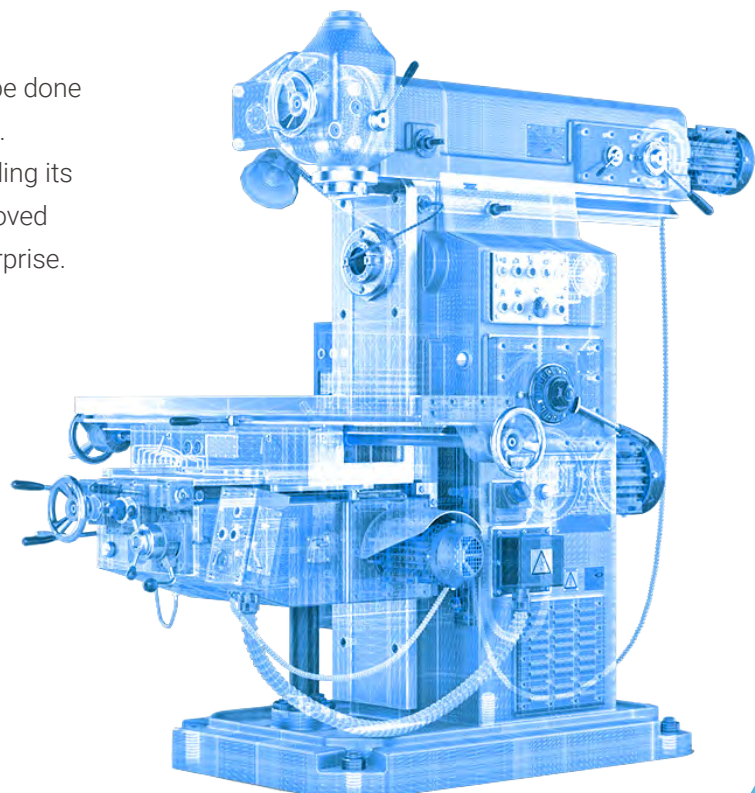
Map out the possibilities in which digital twins could benefit your business. Create a list of scenarios in which the product or process would be valuable enough to invest in building a twin. After this list is created, assess the scenario with members of operations, technical and business to identify processes that can provide benefits from using a digital twin.

Testing is important to maximise the returns on the initial investment. Work quickly through this stage to allow adaptability and integration with new data and leverage this technology. When initial value is delivered, build momentum on this to deliver greater results.

Industrialisation of the digital twin development and deployment should be done once success in testing has been seen. Develop insights on the process, including its performance enhancements and improved governance, and publish to larger enterprise.

Scaling is important within the digital twin process. At this stage, businesses can utilise the lessons learned from testing to scale quickly. When scaling, continue to correspond the value of your digital twin process to shareholders.

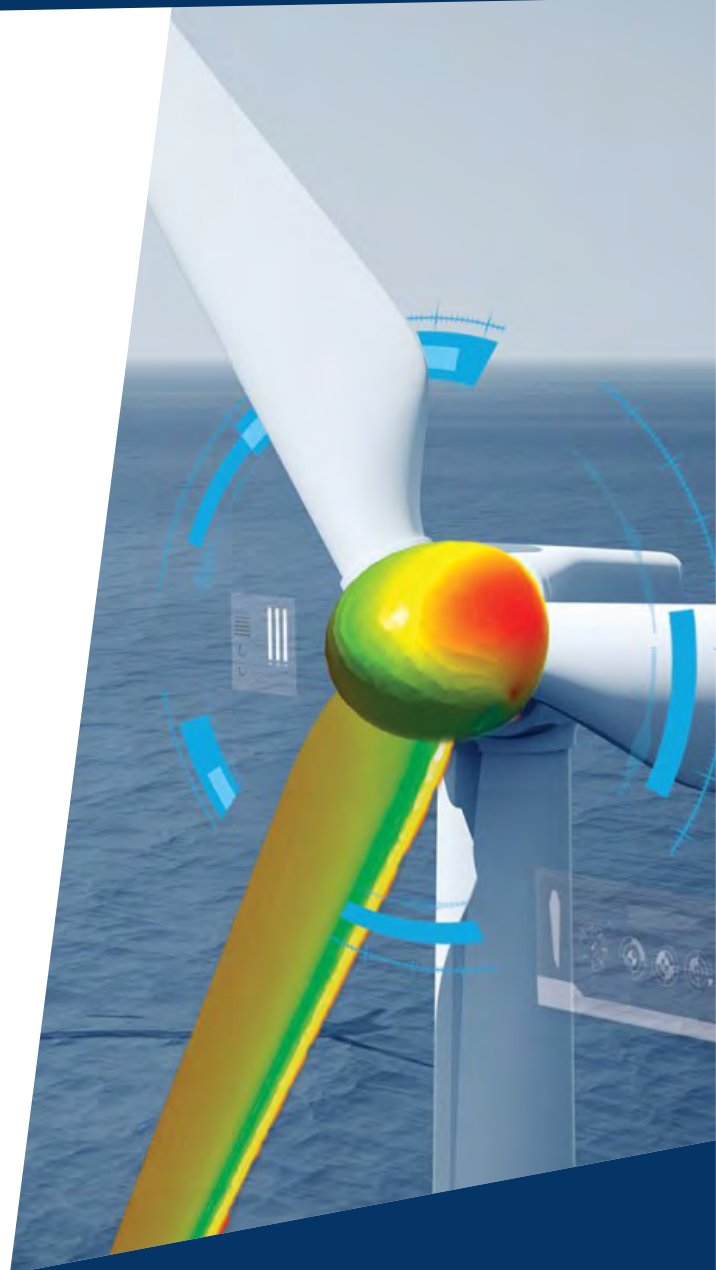
Monitoring and measuring solutions will be essential to demonstrate the value brought from the digital twin. Identify the benefits of the process and diagnose the potential issues. Continue to make adjustments and monitor the results to improve the process.



CONCLUSION

It is evident that digital twins can be advantageous for enterprise, increasing profits and aiding existing supply chain issues. The improved technology will allow for increased capabilities such as flexibility and reduces costs. The power and application of digital twins will continue to grow, providing value and answers to questions that were considered implausible just a decade ago.

Gartner predicts that by 2021, half of large industrial companies will use digital twins, resulting in those organizations gaining a 10% improvement in effectiveness. The quicker your business applies digital twin technology in its process, the further ahead you will stay in front of your competition.



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