AXISCADES

The Dawn of **Digital Twin**

Whitepaper

Digital twin, in simple words, is the virtual model of a product, a process or a service. The concept of a digital twin has been around for quite a while but after the advent of the Internet of Things (IoT), it has become imperative to business due to its cost-effectiveness.

The pairing of the virtual and the physical world allows the prior analysis of data and system monitoring to ward off problems before they even occur, prevent downtime costs, plan for the future and develop new opportunities using simulation.

Digital twins are an important asset for manufacturing companies because they can be applied across the entire lifecycle of an engineering process and strengthens the foundation for connected products and services. Digital twin technology is important because, it has the most advanced monitoring, predictive and analytical capabilities.

The new age of manufacturing: Digital Twin

Digital twin and Industrial IoT can be considered as a live model that is used to leverage business outcomes. It is implemented in various ways within the manufacturing sector. There are three major impact zones of digital twin in the manufacturing business sector:

1) Production & Design:

A digital twin can optimize the efficiency in the production stage by predicting the failures before they can affect the manufacturing process so that it can be fixed prior. By adjusting the parameters in the production line of the twin, several improvements can be stimulated, without causing any harm to the production. The real simulations can then later be applied to the real system. In addition to this, behavior deviations can be analyzed, which can later be used to assess and influence the future developmental iterations of the product.

2) Products in the field:

It is possible to enable remote commissioning and diagnostics of the product with the help of industrial IoT digital twins. This helps in lowering service costs and improving customer satisfaction. If there is a requirement for a technician to troubleshoot an issue in the product, the problem can first be remotely diagnosed in the twin so that the necessary equipment and the parts can be ordered. Further, the configuration of the new products that are to be delivered to the customers can also be done remotely.

3) Future Products:

Based on the behavior of the existing products, new insights can be derived to create new products. Various parameters like performance and customer usage are fed into the product development and manufacturing process. This will help in boosting the product margin, customer satisfaction as well as market share.

The Engineering & Technology behind a Digital Twin

The creation of a digital twin can appear to be quite daunting at first but the engineering of this virtual twin can be broken down into three steps.

1) Design:

- Two elements are crucial to the design of a digital twin. The first step is to select an enabling technology that should be integrated into the physical asset within its digital twin to enable the real-time flow of data from the IoT devices. Apart from this, the integration with operational and transactional information from the other enterprise systems will also be carried out. To overcome the risks associated with identifying the devices in the system, a secure IoT device management is necessary. An identity-driven IoT platform allows you to authenticate, configure, provision, monitor and manage quickly and securely.

- This takes us to the second element of design. There must be a clear understanding of the type of information required across the span of the lifecycle of the product, where the information is kept and how can it be accessed. The information must be reusable and it must be ensured that it can effectively be used between systems. The IoT platform assists in managing the identity of all the elements in the digital twin. It manages the messaging system to enable secure communication between these systems, people and things.

2) Operation:

The purpose for which the digital twin will be used for must be clearly defined before beginning the operation process. Some of the questions that need to be answered are:

- Is it for monitoring the asset?
- Is it to control and alter the asset?
- Should the data from the asset be available for advanced analytics to assist with predictive maintenance?

- Should the data and models within the twin perform simulations to help with operational performance and product development?
- The answers to these questions will ascertain the kind of devices that you need to attach to the asset and also if you wish to use more sophisticated devices that will allow information processing to the move to the edge. It will also establish integration and date preparation and identifies management requirements.

3) Augmentation:

- The digital twin implementations begin at a very small scale with the monitoring of the asset's performance and expand eventually overtime. This happens in two ways; the organization brings together several smaller digital twins to create a complete picture of a machine or a business process. Later, several other sophisticated capabilities are added, like simulations into an existing digital twin.

- In either case, you must layer the functionality within the digital twin to meet the requirements. The functionality should be added securely along with maintaining the performance to meet the extra data that should be gathered.

Implementing a digital twin approach

The implementation of the digital twin is based both on the business outcome and the sophistication of the business logic. Below are the capabilities and the business scenarios of the connected assets and products.

- **Twin-to-device integration:**

The physical object has to be securely connected to the digital twin and this may happen before the installation or after that. Streams of live data require parameters like protocol conversion, semantic mapping, and transformation before it is fed into a data store infrastructure.

- **Twin-to-twin integration:**

Integration with a digital twin by a service provider or a supplier might be necessary if the physical object is not maintained by the provider of the digital twin.

- **Twin-to-system-of-record integration:**

This denotes the integration of business information and engineering systems which provides essential context all along the lifecycle of the physical device or object.

- **Twin-to-system-of-intelligence:**

Digital twins interact with systems of intelligence using events and notifications and take care of condition monitoring and historic information like rule handling, machine learning, and data science algorithms. These are monitored to create streams of live data and give predictions on the future state.

Applications of digital twin

Digital twin applications can be majorly seen in the following sectors:

- **Manufacturing:**

The digital twin is all set and has already begun to change the current face of the manufacturing sector. It has a remarkable impact on the way the products are being designed, manufactured and maintained. Digital twin makes way for a more efficient and optimized method of manufacturing by also reducing the downtime costs.

- **Automobile:**

A digital twin can be used to create a virtual model of a connected vehicle. It helps in capturing the behavioral and operational data of a vehicle and analyzes the overall performance of a vehicle as well as its connected features. It enables delivering a completely personalized or customized service for the customers.

- **Retail:**

Satisfying customer experience is the key to the retail sector. Implementing the digital twin plays a main role in enhancing the retail customer experience by creating virtual twins for customers and creating the necessary modifications to it. It also assists with instore planning, energy management and security implementation in an optimized manner.

- **Healthcare:**

Right from cost savings to preventive maintenance, patient monitoring, as well as personalized healthcare, digital twin and the data from IoT, play a big role in the healthcare sector.

- **Smart Cities:**

Planning and implementing smart cities with digital twin and IoT data helps in augmenting economic development, reducing the ecological footprint, efficient management of resources and develops the overall quality of people's lives. The city planners will receive major insights from various sensor networks and intelligent systems by making use of a digital twin model. This data from the digital twin will help policymakers in making informed decisions about the future as well.

- **Industrial IoT:**

With the digital twin implementation, industrial firms can now digitally monitor, track and control industrial systems. The digital twins can read environmental data like location, financial models, configuration, etc. apart from the operational data. This, in turn, helps in predicting future anomalies if any as well other major operations.

The future of digital twin

Within the next five years, there will be billions of things that will be represented by a digital twin. The proxies of the physical world will pave the way to new collaboration opportunities among the product experts and data scientists. Digital twin technology can help in driving innovation in business by helping companies improve the customer experience, by understanding more in detail the customer needs, enhance the existing operations and services.

The notion of machines making informed decisions, talking and reasoning with each other will be a transformative approach to how industrial systems will be managed and operated in the future. It is estimated that during the decade of 2020-2030, there might be over 50 billion machines that are connected with about 7 billion internet consumers. With the way the network is in play, the world might even see another major starling internet transformation.

What AXISCADES does

AXISCADES can support tailored digital twin models for any process or system towards optimizing operation decisions & profitability.

Our offering:

- Physics-based models coupled with Field-based digital clone models capable to predict performance & damage to reduce downtime and extend life.
- Effective integration with CAD, CAE, and PLM with real-time data measurements.
- Finite element based simulation (eg: structural load analysis).
- Predictive models for condition-based failure monitoring of any system.

AXISCADES

AXISCADES is a leading, end to end engineering solutions and product company. We bring expertise that caters to the digital, engineering and smart manufacturing needs of large enterprises. With decades of experience in creating innovative, sustainable and safer products worldwide, AXISCADES delivers business value across the entire engineering lifecycle.

Our deep domain expertise and engineering solution portfolio covers the complete product development lifecycle from concept evaluation to manufacturing support and certification for the Aerospace, Defense,Heavy Engineering, Automotive, Medical Devices & Industrial Product industries.

AXISCADES is headquartered in Bangalore and has offices across India, North America, Europe and the Asia Pacific region.

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