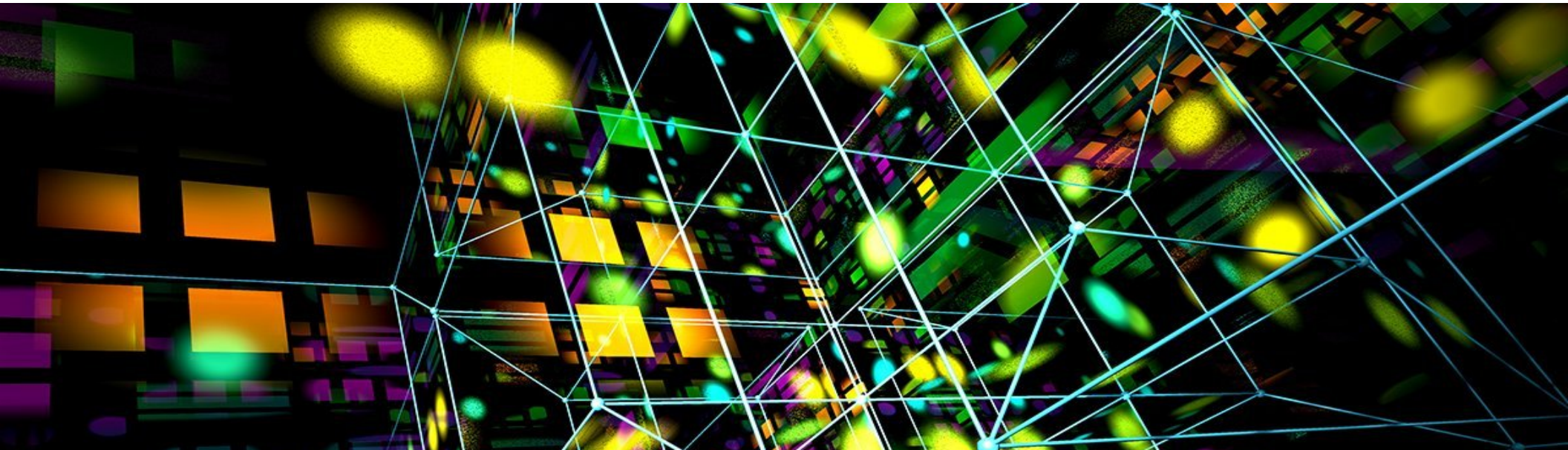
TechTarget | IoT Agenda

E-guide

PRO+ Content

Using Digital Twin Tech to Solve IoT Issues



In this e-guide

In this e-guide:

A digital twin technology, or a virtual representation of a product, is a critical concept in IoT that's still being sorted out.

With digital twins, IoT device product lifecycle management (PLM) can be improved by aggregating IoT data with data from CRM, ERP and product specifications.

This makes it easier for product managers and engineers to correlate design, customer satisfaction, device performance and device reliability.

Keep reading to discover more about digital twin technology:

- **The benefits to IoT (development, PLM and understanding IoT device interactions)**
- **Why it's important for manufacturing's future**
- **7 use cases**

In this e-guide

Using digital twin technology to simulate IoT

George Lawton, Contributor, SearchMicroservices

The idea that a "thing" in the real world has a digital representation in cyberspace may have its roots in William Gibson's 1984 novel *Neuromancer*, but when companies talk about "digital twins" these days, they mean something considerably more recent, just from the past couple of years. In this instance, the process of designing products digitally and expressly tying the manufactured product to its design representation over a period of use is something that Industrie 4.0 is only just beginning to sort out.

Their appearance is clear, as a digital twin technology approach can facilitate:

- understanding IoT device interactions;
- development; and
- product lifecycle management (PLM).

An aircraft manufacturing plant uses digital twin technology from Swim.AI, for example, to monitor, analyze and optimize inventory management using data from tags on various components.

In this e-guide

Xcel Energy Inc., a major U.S.-based electric and natural gas company, implemented a digital twin app using GE's Predix Platform to help increase the efficiency and tracking of information across its hundreds of employees. This reduces the time spent manually updating data and cases, resulting in enhanced visibility into asset and plant performance, as well as easy visibility into best practices across the enterprise.

Digital twins improve development by allowing developers to use programming instructions to directly manipulate the abstract version of the device itself, letting the system underneath the twin concept sort out the niceties of transferring new data and machine state to the physical twin. The immediate focus is thus on the application logic rather than the details of communicating with the device. For example, Amazon Web Service's Greengrass technology allows developers to code against a device shadow.

With digital twins, IoT device PLM can be improved by aggregating IoT data with data from CRM, ERP and product specifications. This makes it easier for product managers and engineers to correlate design, customer satisfaction, device performance and device reliability.

IoT brings more comprehensive modelling

The idea of virtual representation of the real world is as old as computing itself. However, early models focused on specific problems tailored to

In this e-guide

industrial assets. "This narrow focus tends to limit solutions using those models to particular areas and a narrow class of assets, reducing the applicability of these models and the ability to deliver differentiated customer value through true end-to-end system or network optimization," said Patric McElroy, vice president, chief software engineer at GE Power.

For example, in the power industry, the focus was traditionally on a part of the network rather than the entire system itself. Modern digital twin technology that brings in data from across different systems can help engineers achieve a more diverse set of goals. They can also make it easier to use machine learning to correlate a much wider set of data to look at relationships across assets to enable and deliver true network-level optimization. Cross-referencing data also makes it easier to detect and correct anomalies.

Understanding

Digital twins can make it easier to correlate data from multiple IoT devices for industrial IoT. Enterprises can equip machines with sensors that collect operational data that reflects the machines in the context of the environment as a whole. "Using a digital twin, you can consolidate and analyze these data sets, as well as replicate production processes in the virtual world," said Gerald Glocker, director and chief product owner for

In this e-guide

engineering cloud services at Bosch Software Innovations, GmbH. Over time, deviations in performance might become apparent. Manufacturers can then take action and optimize their production processes.

Digital twin technology can also be of use in the context of a connected building. For example, designers could simulate how a building is used based on historical or comparative data and test out changes in the building's design. This might call attention to rooms that are wasting energy or are used rarely, Glocker said.

Environmental twins

Digital twins needn't be restricted to designed, manufacturable aspects of production. Twin modelling is also being used to create interactive models of the Earth to help enterprises make better predictions. Descartes Labs Inc. is building such a model by fusing data from satellites, logistics data from IoT devices on trucks and other sources to correlate commodity production with enterprise processes. Fritz Schlereth, Descartes Labs' head of product, said, "By simulating what is happening on the planet, you can begin to predict production and demand as commodities are generated, predict substitutions within the supply chain and predict shifts between supplier and consumer both globally and locally."

In this e-guide

Useful models need to allow developers to take advantage of the global scale of the digital twin, must be accessible via the same API and have to consider historical data. The models need to run continuously onward to offer new insights and intelligence. Schlereth said, "The key to making the digital twin accessible to users is to clean the data so it is ready for scientific use and to index the data so that it is searchable. Making the data searchable requires storing metadata that describes each image and indexing it efficiently.

Development

Digital twins can also provide an abstraction layer for developers to make it easier to securely code IoT apps. Ian Skerrett, an independent IoT market adviser, said, "The importance of a digital twin is that it allows integration of the physical device to other OT/IT systems. An advanced API will make it easier for developers to do this type of integration."

For example, Bosch IoT Things enables applications to manage digital twins of their IoT device assets. Applications can store and update the data, properties and relationships of their domain's assets and get notified of all relevant changes via well-defined APIs. Those APIs are exposed via HTTP, WebSocket and AMQP.

In this e-guide

This kind of an approach makes it easier to manage and organize digital twins of IoT devices, find things by their dynamic properties or static attributes, and securely communicate with them. Bosch has aligned these capabilities within the open source Eclipse IoT framework, Eclipse Ditto. For developers, this means that APIs of Eclipse Ditto are fully compatible with APIs of Bosch IoT Things. This brings a lot of flexibility, sustainability and trust.

Skerrett said enterprises should explore the openness of their digital twin technology in order to cultivate long-term value. He explained, "We are seeing a lot of the existing industrial vendors that have simulation capabilities extending these to be called digital twins. The next step needs to be better developer tools to create digital twins independent of engineering software, like computer-aided design systems. If digital twins are to become a general industry concept, there will also need to be some work done on consistent definitions of capabilities and APIs."

Product lifecycle management

Another use case for digital twin technology championed by PTC lies in correlating data related to a device across its entire lifecycle. Francois Lamy, vice president of PLM solutions management at PTC, said, "For us, a digital twin combines data from the device itself along with the experience

In this e-guide

of the product." This can include aggregating data from design artifacts, manuals, service and parts information. The data might come from engineering applications, CRM, ERP and service management applications."

This can help bring new insight to frontline workers, as well as product managers and engineers working on new devices.

For example, a car manufacturer might use IoT data to observe that drivers in Switzerland go through breaks faster because of the hills there. Lamy said, "It is not like this is in and of itself remarkable, but if I can put that information in the context of my design, I can focus on the actual usage of the product."

From this perspective, the digital twin provides a coherent view of the product. It also requires figuring out how to orchestrate data from these different systems in a way that is useful for engineers, managers and frontline workers in their own context. This involves protocol bridging across different technologies and interfaces. "The big issue is that you are swimming in oceans of data and it is locked in various silos," Lamy said.

The fields of application for digital twin technology are manifold and not confined to a specific industry or area; they can be used for a wide range of scenarios. On one hand, there are digital twins that just model and represent a single sensor within a device. On the other, there are digital twins that

reflect a whole campus of buildings with a lot of aspects regarding energy, usage, topology and more.

So, what's next?

There is potential for the adoption of digital twins to increase as companies evaluate use cases and find out where they can be beneficial to them. "In the coming years, we expect greater customer requirements in regard to the modeling of twins, which includes semantics and simulation," Glocker said.

Digital twin technology use cases

Simon Crosby, CTO at Swim.AI, said digital twins can be used in many industries including:

- **Industrial businesses for predictive maintenance:** Complex industrial setups to automatically find digital twins, identify anomalies and predict their future performance.
- **Manufacturing for asset tracking and production lines:** Tracking hundreds of thousands of RFID-labelled entities to determine their positions in 3D-space and automatically determine whether a complex assembled subassembly contains the right parts.
- **Traffic:** Digital twins of traffic lights, traffic flows, vehicles and pedestrians enable better information and predictions of actual traffic across cities.

In this e-guide

- **Cable set-top boxes:** Set-top boxes in homes often use multiple technologies (Wi-Fi, Bluetooth and Ethernet, to name a few) and often experience local issues with buildings, connectivity and clashing networks. Digital twins can learn locally and help improve in-home performance.
- **Connected vehicles:** New connected vehicles provide a lot of information about their performance, maintenance and surroundings. Digital twins can be used locally to provide better information to drivers, passengers, insurers and vehicle manufacturers.
- **Smart cities:** New devices, sensors and meters enable much better tracking of actual conditions in cities. Digital twins can understand and deliver better citizen information, smart grids, smart lighting, smart parking and a host of new services.
- **Health and personal devices:** The amount of new data on connected personal devices is rapidly increasing. Digital twins can be used locally to understand and interpret data quickly, enabling better monitoring and flagging changes.

Next Article

In this e-guide

Why is digital twin technology important for manufacturing's future?

Dave Turbide, Consultant and Freelance Writer, SearchERP

The digitization of manufacturing is firmly established as the future direction of manufacturing technology, including in the industrial internet of things and Industry 4.0 -- and digital twin technology is key. Think of the digital twin as the embodiment of these megatrends.

Digital twin technology is not an application that you can buy from your ERP or computer-aided design (CAD) system supplier. It is a concept that is embodied in your approach to product lifecycle management and digital manufacturing. CAD typically creates the digital twin -- the basic identity and definition of the digital object. From that point on, data is collected into and linked to the digital twin.

In essence, a digital twin is the virtual representation of a physical product with data linking the two. A digital twin is created in CAD and modeling software that designers and engineers use in the early stage of product development, which is kept for later stages of the product lifecycle.

In this e-guide

Digital twin technology enables an electronic description of a physical part or product. Sensors can collect data from the physical product and send it back to the digital twin, and this communication can help optimize the product's performance. In essence, it is the "container" for all of the digital information that is accumulated from initial design, development, manufacturing, distribution, use, maintenance and disposal for the life of the item.

By linking all information together within a single identity, digital twin technology becomes the basis for all support and maintenance, further development and engineering, and overall management of the item or product. In this age of the industrial internet of things and digital manufacturing, the biggest challenge many companies face is making use of the big data flooding our systems and networks. The digital twin offers an anchor and organizing cross-reference link that can help give that data context and meaning.

Next Article

In this e-guide

IIoT analytics opportunities for manufacturing, industry

Linda Rosencrance, Contributor, SearchERP

Many argue that the internet of things in industrial settings has been around for decades in the form of industrial control systems technologies, such as supervisory control and data acquisition, programmable logic controllers and machine-to-machine communications. However, the true potential of industrial IoT only shone after the introduction of data-driven analytics.

Increasingly, IIoT analytics is providing a number of opportunities to manufacturing and industrial organizations alike -- from helping them better understand business processes to reducing unplanned downtime to increasing profitability and efficiency.

"There are more and more cases where you're actually seeing good benefits from IIoT and companies being able to implement it in an intelligent fashion," said Seth Lippincott, an analyst at Nucleus Research in Boston. "It's getting to the point where you can do much more of the [predictive] maintenance side of things."

In this e-guide

For example, a service company that provides refrigerators to supermarkets could add smart sensors to the systems that would provide real-time temperature information as well as other metrics, including how the motor is running. Then -- if the refrigerator isn't functioning the way it should, given the time of day or the location, for example -- the service company can send a technician out to the supermarket to take a look, Lippincott said.

"But the most interesting step these service companies are taking is being able to send a push notification or email to one of the supermarket employees on site, who can then run the necessary troubleshooting procedure without even requiring a service call to begin with," he said. "Then, only if the troubleshooting didn't work, the company would send a technician."

Predictive maintenance, a top IIoT benefit

From a value perspective, predictive maintenance is one of the greatest benefits of IIoT analytics, Lippincott said. "If you can get your customers to service the [equipment] rather than your technicians, you're saving a ton in their time as well as on the equipment," he said.

It will eventually get to the point where a company won't even need to proactively contact the customer to run the troubleshooting, Lippincott added. Instead, the customer will get an automated message about what

devices need troubleshooting or services. "And they could do that without even having to coordinate with the service company's technicians," he said.

Track your assets better with IIoT

IIoT analytics is also beneficial in terms of asset tracking, said Sam Tawfik, IoT program director at Northeastern University Silicon Valley in San Jose, Calif. Companies can tag their assets, such as trucks and cargo, to track location and ensure schedules are met, he said.

"Are they where they're supposed to be for the next shift? Did something happen? Are they being delayed? Do I need to reroute some assets [to cover that delay]?" Tawfik said. "IIoT helps gain complete visibility across the supply chain to keep it moving."

Another one of the major benefits of IIoT analytics is that they allow firms to use embedded or add-on trackers on assets, products and shipments to determine their locations and context, said Frank Gillett, an analyst at Forrester Research, in Cambridge, Mass. This allows companies to analyze that data and offer transparent service levels, as well as track compliance with certain requirements, such as refrigeration temperature.

Richard Soley, chairman and CEO at Object Management Group Inc. in Needham, Mass., said IIoT analytics is having a major effect on existing

In this e-guide

business models. By giving manufacturers the ability to keep connectivity long term with the products they build, IIoT helps them provide better service and therefore can create a better experience for end users. Many companies, he said, are now shifting their business model toward providing their manufactured goods as a service, rather than just as products.

For instance, General Electric, which makes jet engines, has switched from a capital sales model to a lease model, leasing its jet engines on a propulsion-as-a-service basis, Soley said. And GE can take advantage of its vast amount of historical performance data to keep the engine running in excellent condition.

"The new GE business model is 'let's keep connection to the device that we build long term and put sensors on the device that I'm going to be attached to forever -- over the internet. Then we lease it to the customer, so the customer doesn't own it and -- more importantly -- so I have connection to it for long term,'" Soley said.

The vendor, GE in this case, will make more money selling propulsion as a service in the long run than it would by selling the jet engine. And the service, in turn, will ensure better customer satisfaction. "Airlines don't want jet engines; they want propulsion," Soley said. "So sell them what they want."

Next Article

In this e-guide

About IoTAgenda

IoT Agenda covers all aspects of Internet of Things technology and strategy as it relates to enterprise IT, including the technologies that enhance and enable internal business processes, and the resulting IoT products themselves -- the "things" that the business produces.

Our coverage from award-winning editors and leading industry experts readies businesses looking to deploy monitors in the field, embed sensors to help them improve products, manage their inventories and supply chains, and distribute intelligence to improve their work environments and production floors.

This is new territory, and IT and business professionals need expert assistance to make the leap. IoT Agenda is the leading site focused on the needs of enterprises grappling with IoT.

For further reading, visit us at https://InternetofThingsAgenda.com

Images; Fotalia