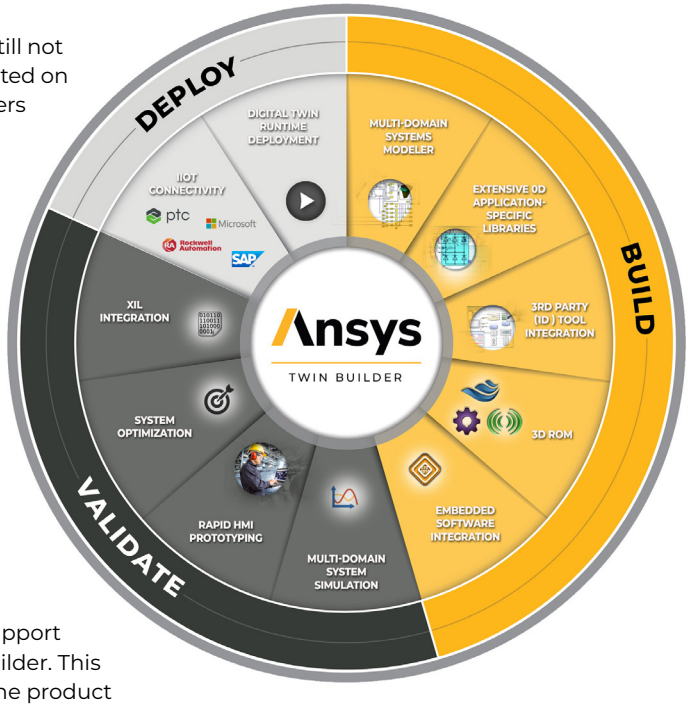
WHITE PAPER

EDGE COMPUTING: NEW SUPPORT FOR DIGITAL TWINS

Digital twins are one of the most exciting technology developments to emerge over the past few years. By creating a virtual model of a physical product, then simulating its real-time operation, companies are optimizing maintenance, predicting critical maintenance events and fueling innovation via actual performance feedback. Because simulation requires computational resources and the associated data outputs are large, cloud computing — with its scalability and relatively low cost — has traditionally been the technology environment of choice for supporting digital twins. But today, edge computing has emerged as a promising alternative. Edge computing leverages local resources that are close to the physical product's location, which means reduced latency, while improving responsiveness, agility and privacy. For companies that are interested in creating digital twins, but have not taken the leap yet, the advantages of edge computing might convince them to explore this advanced practice — and begin capturing valuable insights about their operations.

Executive Summary

The term "digital twin" is trending, but the majority of businesses are still not capitalizing on this advanced technology. By leveraging sensors mounted on physical products to capture real-time data, digital twins allow engineers to gain an unprecedented level of insight into real-world operating performance. They can schedule preventive maintenance, optimize operating parameters, eliminate breakdowns and even optimize future product development efforts. Today, a new approach called edge computing is placing digital twins within the reach of more companies. By using localized technology resources — from dedicated servers to small-scale computers — to collect and process real-time operating data, companies can avoid the unexpected costs and delays that can be associated with large-scale cloud computing. Edge computing holds the promise of making a digital twin strategy much faster and less expensive to implement. But is edge computing the right choice for your business? With the industry's leading physics-based simulation toolkit, and a range of specialized digital twin solutions, Ansys can help you make smart, informed choices that deliver the highest return on your digital twin investment.



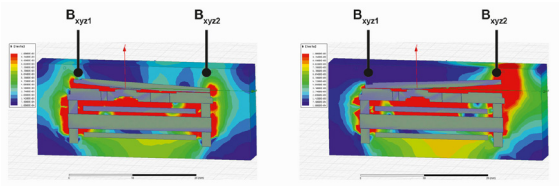
Ansys Twin Builder is a unique solution that guides companies through the process of building, validating and deploying digital twins.

In addition, Ansys has developed a set of specialized solutions that support the creation and application of digital twins, including Ansys Twin Builder. This advanced solution leads engineers through the process of building the product model, then verifying and optimizing its performance by comparing it to test data. As engineers replicate the real-world environment in which the product system will operate, Twin Builder cuts time and costs by allowing engineering teams to re-use both models and data from the original product development process.

Because Ansys simulation solutions support both the development and creation of digital twins on a shared technology platform, they leverage the power of digitalization to bring the engineering and operations teams closer together in a collaborative ecosystem. In addition, Twin Builder is built to leverage and integrate with customers' existing technology assets, including embedded software, 1D and 3D models, and linkages to a broad range of IIoT platforms. Twin Builder's support for multiple modeling domains and languages — as well as its intuitive interface — make it seamless and straightforward to create, verify and deploy a digital twin for virtually any customer application.

A Key Consideration: Choosing the Right Technology Environment

While Ansys makes the choice of a simulation platform easy, companies exploring the digital twin concept also need to consider the larger technology environment in which their working product models will exist. Because these models typically involve complex models, depend on huge volumes of data and consider dynamic performance, they necessarily require large amounts of computational power. Companies investing in digital twins require a robust computing environment that not only supports the connection of the model to the working product via the IIoT, but has the bandwidth and responsiveness needed to process high volumes of real-time performance data. The computing environment also needs to support a response speed great enough to apply insights in a timely manner. Often, there is a performance or maintenance issue identified that is critical, and the operations team needs to be notified immediately.



Phoenix Contact Electronics engineers used Ansys Twin Builder to develop a digital twin of its safety relays that helps predict failures in advance. In creating and managing such a numerically large model, choosing the right technology environment is critical.

The Proven Advantages of Cloud Computing

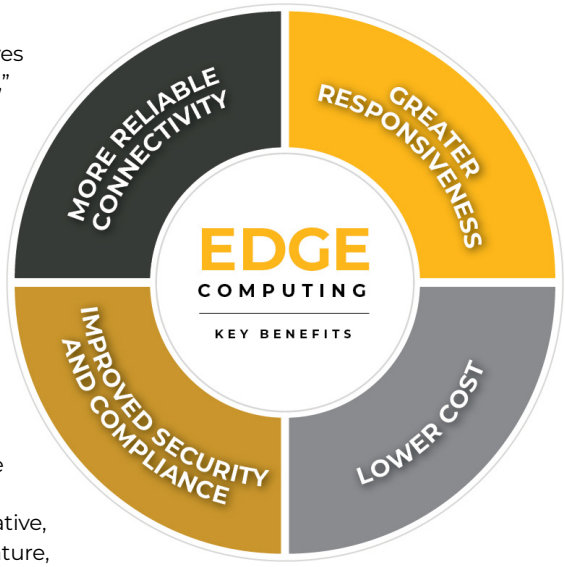
Because few companies are willing to invest in on-premise resources to support their digital twin initiatives — including hardware, software and processors — cloud computing has quickly become the preferred technology environment for hosting the needed IIoT computational resources.

A cloud-based approach is usually cost-effective, because the technology resources are flexible and scalable. As additional processing or storage capacity is needed to scale out operating problems, it can be added easily and seamlessly, without making a long-term commitment. Cloud providers ensure that IT resources always reflect the state-of-the-art, so companies can avoid making their own ongoing investments in physical computing assets.

In addition, since cloud hosting is readily available, this approach supports a fast implementation of digital twins via Ansys Twin Builder. The solution can be up and running rapidly, without any concerns about speed, capacity, bandwidth or long-term resource commitments.

Edge Computing: A Promising New Capability

While cloud computing has proven successful in supporting the digital twin initiatives of many organizations, today a new capability is emerging. Called “edge computing,” this strategy leverages technology resources that are in close physical proximity to the asset that’s being monitored. Instead of sending data to a remote location and computing on physically distant IT assets, edge computing eliminates any degree of lag time because it’s faster and easier to process information near the source. How fast is edge computing growing? Gartner has predicted that “By 2022, more than 50% of enterprise-generated data will be created and processed outside the data center or cloud.”[1]



By allocating data collection, processing and analysis to the “edges” of the overall computing network, edge computing decentralizes the workload and avoids using a centralized data center or cloud unnecessarily.

While cloud resources are elastic, at times there can be tremendous increases in the volume of requests, especially when hundreds or even thousands of IIoT devices are simultaneously sending data or processing queries. In the case of a digital twin initiative, the real-time information generated by an operating machine — including temperature, vibration and pressure levels — is captured by IIoT sensors and then typically converted to a different data format for analysis. If this data is then sent to a cloud, processed and sent back, delays may result. The insights generated may be far from “real time” when they are finally applied. By leveraging edge devices, companies can increase processing speeds, improve data accessibility and eliminate the “noise” and latency that result from transmitting data over great geographic distances to a shared cloud resource.

For organizations that are strictly regulated by the industry or the government, edge computing offers an additional advantage. Data security and compliance may be more easily achieved if processing is accomplished via a private, local network of technology resources. Uploading data to a cloud, even a private cloud, may violate regulations and put sensitive data or equipment controls at risk.

Edge Computing: Some Real-World Applications

In what instances would edge computing make sound business sense?

Consider the example of an oil rig in the middle of the ocean with a pump that is about to fail. Eliminating any degree of latency by collecting and processing the pump's sensor outputs locally, on edge devices, might make a critical difference in averting this failure via preventive maintenance. In instances like this, where high-speed internet connectivity is not available and sending large amounts of data is simply not feasible, edge computing provides the answer.

Even if the growth of edge means increasing adoption of decentralized computing, it's important to note that this does not mean that edge will replace the cloud. Rather, edge and cloud computing can exist in a symbiotic relationship.

For example, many manufacturers currently rely on a cloud infrastructure to gather and process operating data. But adding edge computing in a hybrid approach helps ensure that real-time operating data is stored in an accessible, scalable location. Manufacturers can easily capitalize on sufficient computing power and fast processing speeds without expensive outlays for on-premise IT investments.

By leveraging edge computing and Ansys digital twin technology in tandem, manufacturers can identify and respond quickly to rising temperatures, dust or emissions, fatigue, vibration, high levels of energy consumption and other signs that equipment is not operating optimally. Operations management can make critical decisions and respond very quickly — or, by leveraging artificial intelligence, companies can automate these responses with absolutely no human intervention and zero latency.

Setting the Stage for Broad Adoption of Digital Twins

When the concept of digital twins was introduced several years ago, it seemed like science fiction — or a specialized simulation application that was relevant to only a handful of industries. However, today the use of digital twins is growing exponentially. From medical devices to wind turbines, railways and industrial equipment, digital twins are helping companies optimize the lifetime performance of their products, minimize downtime, decrease warranty and maintenance costs, and support new value-added product designs.

With a family of specialized digital twin solutions — as well as the industry's broadest platform of physics-based engineering simulation technology — Ansys is at the forefront of the digital twin revolution. User-friendly, intuitive tools from Ansys have already helped many companies get digital twins up and running quickly, for fast results and a maximum return on investment.

As edge computing and other emerging technologies continue to increase the global adoption of digital twins, Ansys can help customers make the right choices as they embark on the digital twin journey.

Whether a cloud computing model, an edge computing approach or a hybrid model makes the most sense, Ansys can create a customized digital twin plan that considers each organization's objectives, information needs, IT resources, timeframe and competitive situation. As developments like edge computing place digital twins within the reach of virtually every business, there's no reason to overlook this advanced simulation capability that can deliver enormous financial returns — and a meaningful competitive edge.

1 "The Edge Completes the Cloud: A Gartner Trend Insight Report," September 2018.

ANSYS, Inc.
Southpointe
2600 Ansys Drive
Canonsburg, PA 15317
U.S.A.
724.746.3304
ansysinfo@ansys.com

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