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The Complete Guide To Supply Chain Digital Twins

By: Coupa

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If your flight hits sudden turbulence or needs an emergency landing, you'd expect the plane's pilot to know precisely what to do to keep you safe. That's why flight simulators are so important. The digital simulation provides a risk-free and effective way to train pilots to respond to various unexpected situations.

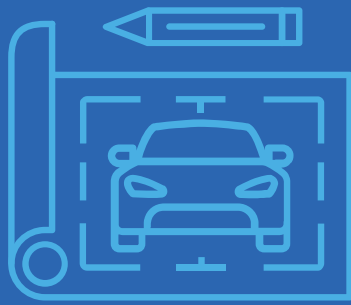
Supply chain digital twins work in a similar way. The technology helps procurement leaders plan, respond to, and outsmart disruptions in their supply chain operations by testing various scenarios. As a result, companies can navigate the volatility that's become all too common in modern supply chains. Between growing economic pressures like inflation, labor shortages like those in high-skill manufacturing, and extreme weather events due to climate change, understanding and applying digital twin technologies to your supply chain planning process has never been more important.

What is a digital twin?

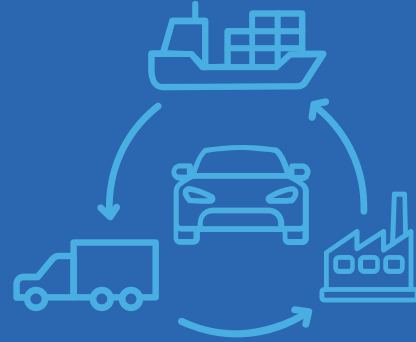
A **digital twin** is a virtual representation of a physical object, system, or process. It uses real-time data to mirror the physical behavior and operations of what it represents. The technology improves decision-making and problem-solving by enabling users to test different scenarios on the object, system, or process in a digital environment.

There are mainly two types of digital twins: product and control tower.

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Optimizes a product's performance and maintenance by testing it under different conditions



Optimizes an entire system or network efficiency by testing it under different disruptions and scenarios

A **product digital twin** is a virtual replica of a physical product. It's used to optimize a product's performance and maintenance by testing it under different conditions, monitoring performance, and predicting problems. A product digital twin is typically used in manufacturing, automotive, aerospace, and healthcare industries to improve product design and extend the product's lifecycle.

A **control tower digital twin** is a virtual representation of an entire system or network, such as a supply chain or logistics network. It provides real-time visibility and control over the entire system's operations, which enables users to make better decisions to improve efficiency, reduce risk, and build resilience across the network. A tower digital twin is typically used in industries that involve supply chain management, logistics, and transportation operations.

In this blog, we'll cover a control tower digital twin type called a **supply chain digital twin**. A supply chain digital twin is a replica or virtual simulation of a physical supply chain. It harnesses near-real-time data from multiple sources, such as ERP data, factory outputs, node lanes, inventory levels, vehicle locations, shipment schedules, market dynamics, and more, to give you an end-to-end view of your supply chain.

With this interactive digital model, you can test scenarios and model different nodes, modes, flows, and policies to understand how decisions and disruptions will impact your network operations. A digital twin helps businesses:

- Test supply chain design changes
- Uncover bottlenecks, poor use of inventory, or inefficient lanes
- Improve transportation planning
- Monitor and identify risks
- Streamline forecasting
- Identify process improvements
- Improve collaboration between finance and procurement

Understanding a supply chain's macro and micro dynamics can help businesses manage and optimize supply chain operations with greater agility.

The need for digital twins in supply chain design

There was a time when people thought about supply chains like they thought about electricity: they didn't. Everything just worked! But then a series of supply chain storms hit, and the power went out.

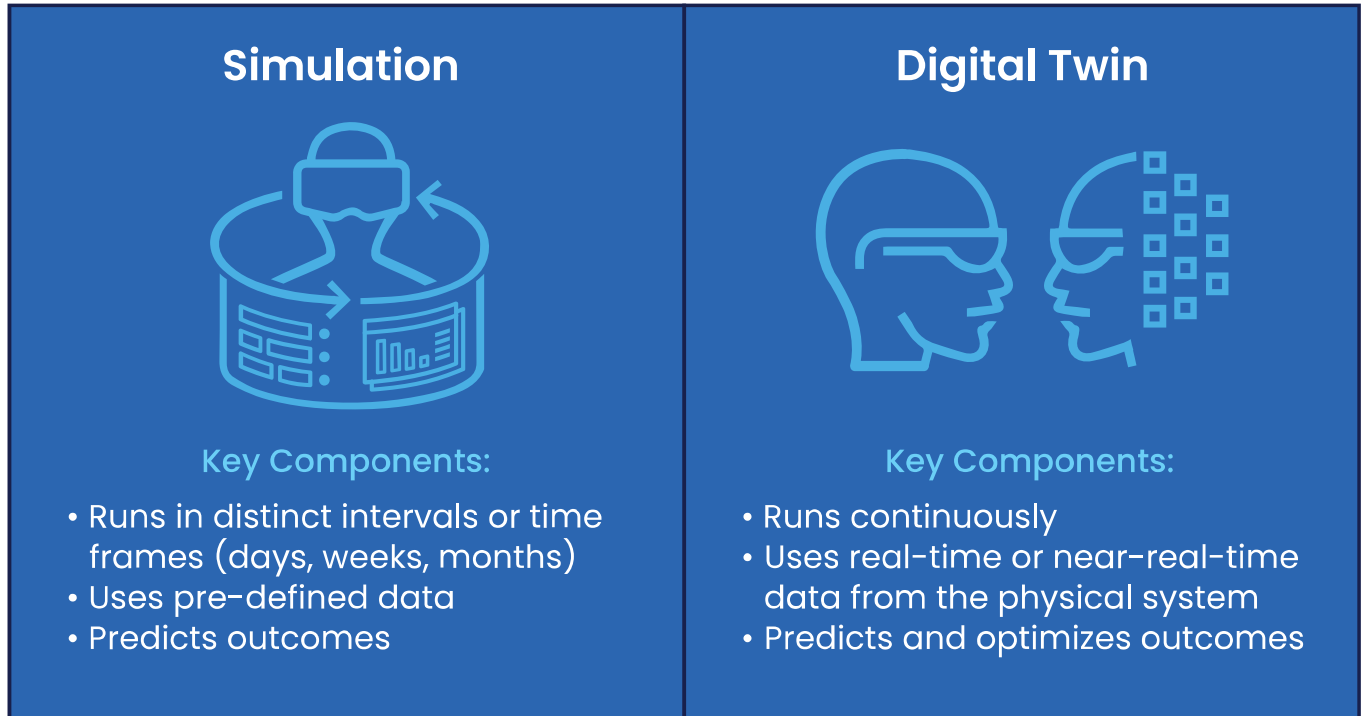
Traditionally, most supply chain planning efforts used a certain set of assumptions about the future of supply. However, many factors (or supply chain storms) now make that approach impractical. Geopolitical conflicts, fast-changing consumer preferences, and transportation challenges have made supply chains so interconnected and complex that a local disruption in one place impacts everything else globally.

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produces the least amount of carbon emissions? A digital twin [can answer all these questions quickly](#).

Supply chain simulation models are another common tool in supply chain design, but they differ from digital twins in a few key ways. A simulation test hypothesizes, evaluates changes, and provides an understanding of the impact of variables on the supply chain. With a simulation, you need to pull and input a large amount of data to predict what might happen in your supply chain.

Meanwhile, a digital twin enables real-time monitoring, diagnosing, and predicting of issues and opportunities for optimization. It not only automatically predicts what can happen but also provides perspective actions on what to do about it.



Despite today's rapidly changing dynamics, most organizations still use static spreadsheets or manual planning approaches to design and plan their supply chains. With a spreadsheet, for example, you need to input all of your supply chain data and then manually manipulate the data to fit and test a certain scenario, like demand forecasting. You can only run one scenario or simulation at a time.

This method also involves emailing the spreadsheets to various stakeholders for review and analysis. As you'd imagine, this approach is time-consuming and prone to errors. It's easy to duplicate cells or input information incorrectly.

Outdated data and over-reliance on assumptions present further challenges with spreadsheet-based simulations. If you're using inventory levels from two weeks ago, your decisions may be out of touch with your current supply chain conditions. Using static models for dynamic, ever-changing, real-world supply chains means businesses are slow to respond or plan for unexpected disruptions and unable to improve operational efficiency.

Digital twins, on the other hand, use real-time information to provide a complete view of the supply chain on a single screen. This gives supply chain leaders the power to stress test their supply chain design across multiple scenarios simultaneously, which is an essential component of building a supply chain that cannot only withstand setbacks but also bounce back quickly after disruptive events like blocked transportation routes and distribution center shutdowns.

Digital twins help organizations make smarter, faster, data-driven decisions to respond — not react — if and when something goes wrong. It also helps uncover areas for operational improvement.

How digital twins improve supply chain resilience

Disruptions and changes are not just something that happens occasionally anymore. They are happening more frequently and with more intensity than ever. The growing threat of the climate crisis is causing strict compliance measures around sustainability and human rights, like the [German Supply Chain Act](#), where reporting capabilities are required. And in an increasingly connected world, the COVID-19 global health crisis we face.

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logistic routes, and more. In essence, they must build resilient supply chains that can withstand even the most unexpected volatility.

Businesses use a digital twin to build resilience against:

- Geopolitical conflicts
- Climate change
- Stricter compliance measures
- Raw material shortages
- Labor shortages
- Fast-changing consumer preferences

A digital twin helps [shorten the time it takes](#) for an organization to go from question to answer. With the ability to run multiple scenarios in parallel, you can answer different questions in different strategic areas at the same time and come to conclusions that are best for the business overall. Some common scenarios businesses test include:

- Alternative transportation routes during port blockages or international sanctions
- Cost impacts when new tax and duty laws go into effect
- New supplier options if a critical material, like a precious metal, becomes scarce

A digital twin [makes your existing systems work better](#), so you can anticipate disruption, create a playbook of options to respond to crises before they happen, or respond quicker to unforeseen events.

Managing supply chain risks with digital twins

Digital twins allow you to model and stress test potential breaking points in your supply chain and take action to improve overall resiliency. You'll be able to identify and quantify risks across your network, analyze and compare results from numerous scenarios on mitigating the risk, and choose the best response for the business.

Here are some common risk and process areas that digital twins can help you address.

Cost-to-serve analysis

[Cost-to-serve](#) analysis helps businesses understand the cost of delivering a product to a customer on a granular level, including transportation, warehousing, and labor costs.

Suppose new cross-country taxes are set to go into effect in the country with your largest distribution center. In that case, you can identify how much it would impact your profitability. With that information in hand, you can then run various scenarios, like opening a new distribution center in a cheaper tax code country or finding cheaper raw materials, to reduce the risk of margin erosion.

Environmental, social, and governance (ESG)

As stricter compliance requirements around carbon emissions and fair labor practices become effective, businesses need transparency and traceability across their supply chains. Without it, they face hefty fines, a lack of customer trust, and a poor brand reputation.

With a digital twin, businesses gain [insights into the environmental impact of various activities](#), like the carbon emissions they produce when transporting products from point A to point B. Additionally, digital twins facilitate the [tracking of suppliers' adherence to labor and environmental regulations](#) by using AI to monitor outside data sources, cross-community data, and user-submitted feedback.

Capacity planning

Capacity planning ensures a company can meet demand without overcommitting resources or facing production bottlenecks. Inaccurate capacity planning can result in underutilized assets or unmet customer demand.

Let's say an earthquake severely damages one of your factories. With a digital twin, you can increase capacity at various factories across your network in order to meet customer demand.

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financial losses, and customer dissatisfaction due to buying soon-to-be expired products.

A digital twin can monitor the condition and locations of perishable goods throughout the supply chain. Businesses can then predict products' remaining shelf life and make informed decisions about inventory rotation and distribution.

Reverse logistics

Reverse logistics, the process of managing returned goods, poses challenges related to cost, efficiency, and customer satisfaction.

With end-to-end visibility of returns across your supply chain process, you can track returned items in real-time, analyze the reasons for returns, and optimize the handling, refurbishing, or disposal of products. Overall, you'll be able to improve efficiency, minimize costs, and ensure customers receive refunds as quickly as possible.

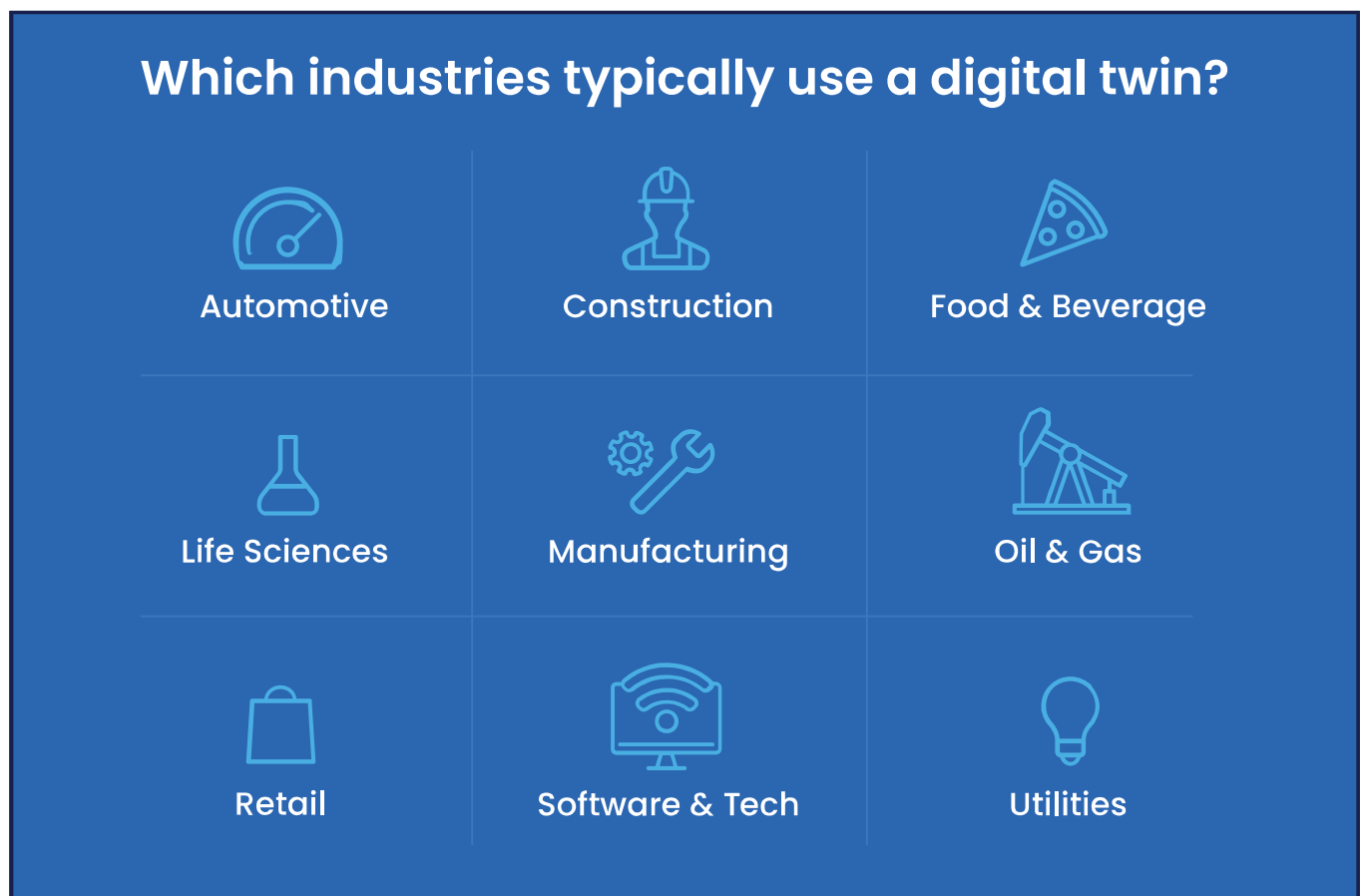
Mergers and acquisitions

Integrating supply chains and systems due to mergers and acquisitions (M&A) involves significant risks and opportunities. When poorly managed, it leads to operational disruptions and financial losses.

Digital twins facilitate smoother M&A by enabling a unified, virtual representation of the combined supply chains. Businesses are empowered to understand how processes will be integrated and identify conflicts or redundancy points before they impact operations.

All types of industries can benefit from digital twin technology

Any organization looking to optimize its supply chain and supply networks can benefit from a digital twin.



While any company with a physical supply chain can use a digital twin, the industries that typically include:

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Food and beverage to understand consumer preferences and optimize the shelf-life

Retail and consumer goods to source materials and respond faster to changes in consumer preferences and demands

Manufacturing to refine complex processes and improve operational efficiency

EXAMPLES: How companies are already employing digital twin technology

Microsoft

Microsoft has ambitious goals to reduce its carbon footprint and adopt more sustainable practices for its global operations. The company sees data around its supply chain as the key to making it happen. With Coupa's digital twin technology, Microsoft **incorporated carbon emissions data** as a core metric in making decisions to reduce their carbon footprint by 40% while ensuring profitability.

For example, by shifting from wood shipping pallets to pallets made of alternative materials, they significantly reduced shipping costs and carbon emissions. Digital technology also helps Microsoft make real-time decisions to better forecast needs during demand peaks, which often happen during the holiday season, as laptops and Xbox products are popular gifts of choice for consumers.

Nestlé

Nestlé provides the food and beverage products everyone loves. However, increasing supply chain disruptions made it a challenge to ensure products were precisely where they should be based on customer demand. The company turned to Coupa to build a digital twin to create an efficient supply chain based on factory output.

With real-time analytics, **Nestlé teams can quickly create and compare scenarios** to see how manufacturing, distribution, and logistic changes can ensure the right products get to the right place. Coupa's App Studio also enables everyone — no matter their technical level — to **utilize the digital twin technology** to make data-driven decisions within their business area of focus. All of this is leading to 60% faster decision-making and greater agility for the company.

AI and the future of digital twins

Despite the need for quicker and more dynamic supply chain planning, many companies are still hesitant to adopt digital twin technology. What's holding them back?

One reason may be the complexity of digital twin technology. Training time, implementation workload, and maintenance costs may deter companies from **embracing the technology**. However, the right **digital twin solution** should offer guided implementation help, an intuitive interface, and dedicated, ongoing support.

AI is also making the technology easier to use. Today, it plays a crucial role in enhancing the functionality and capabilities of digital twins, including:

Data integration: AI-powered algorithms process, cleanse, and integrate large amounts of data from various sources, like IoT devices, ERP systems, and market trends.

Anomaly detection: AI can identify patterns and detect anomalies in real time, such as shipment delays or increased supplier risk.

Predictive analytics: Models can analyze historical sales data, market trends, and external factors — like economic indicators — to predict future demand.

Scenario planning: AI enables the simulation of various scenarios, such as changes in demand, policy implementations, or disruptions, to assess their impact on the supply chain.

Optimization: AI can surface the most efficient routes for transportation considering factors like fuel costs and delivery times or optimize resource allocation such as labor, machinery, and raw materials to meet production targets.

Automation: AI-driven automation can handle routine tasks, like order processing and **inventory management**, to reduce employee workload and prevent errors.

As we look to the future, AI will enhance the visual capabilities of digital twin technology, making it easier to understand disruption or policy changes with a 3D view of the supply chain.

Scenario planning and optimization will be another key area of improvement. Currently, **scenario planning by using AI to provide a key set of scenarios** to test that are likely to produce the best results.

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Turn supply chain design into reality

Ultimately, the goal of using a digital twin is to make your real-world supply chains more efficient, agile, and resilient. Coupa Supply Chain Solutions can help you turn that vision into a reality.

Coupa's technology, powered by LLamasoft, helps you confidently balance tradeoffs and multiply margins in your physical supply chain. Industry experts are also available to guide you through implementation and training, so your people and processes are aligned to get more value from your digital twin.

Build a more resilient supply chain.

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