Discovering innovation with your digital twin

The value of warehouse simulation

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Discover digital twin systems

We all know the importance of innovation for the health of your warehouse operations. Shaving costs, reducing errors, and improving efficiency contribute to bigger wins for the business, and even happier customers. We all want to find it within our business, but innovation won't walk through the door and introduce itself. You need to find it.

But, where do you start? Innovation could be anything from changing a process to making a multi-million dollar investment. It requires exploration, and without the right resources, innovation can be just as risky as opportunistic. Supply chain operations continue to grow in complexity, increasing pressure from your customers and competition. And with so many businesses looking at supply chain and logistics as a critical component of the business, internal motivations to differentiate add pressure to your decisions.

Determining the right move to solve complex logistical challenges needs to be more like surgery, and less like pulling a rabbit out of a hat. Data helps if it is actionable and doesn't require a rocket scientist to understand. Experience offers an educated guess based on what's worked in the past. But, is that enough when making critical, long-term decisions?

How do you know what will move the needle? How can you evaluate the best processes, workflows, technology investments, or partnerships that will separate you from the competition? How do you do this safely, and without bias?

Digital twin: warehouse simulation explained
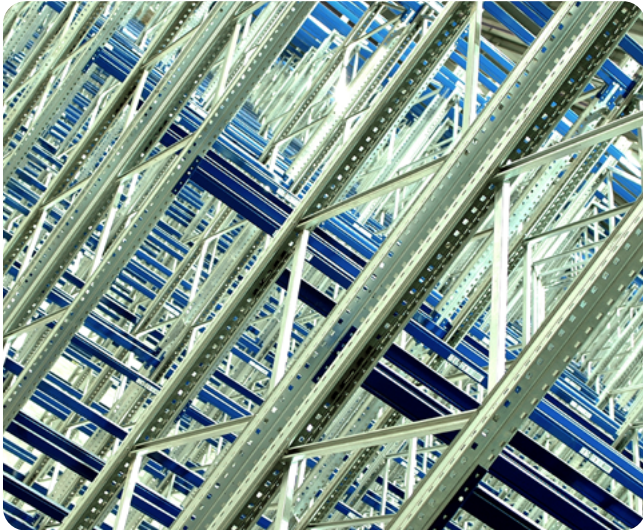
Warehouse design

Analyze strengths and weaknesses of physical space

Critical integrations

Incorporate WMS data for detailed simulations

Workforce analysis

Simulate labor tasks to optimize the workforce

DC network optimization

Better allocate warehouse placement for distribution

Cooking. Dating. Golf. Often before getting it right, we get it (very) wrong. Practice makes perfect. But, there is little room for trial and error when it comes to your supply chain and logistics. However, a digital twin empowers you to take chances because there are no penalties. Getting it wrong in a safe space allows you to apply your learnings and get it right when it counts.

According to Gartner, "in warehousing, a digital twin virtually replicates entities that support fulfillment processes. The most obvious digital twin use case is for anything that can be represented virtually by creating a "digital" blueprint such as through a bill of material, computer-aided design (CAD) diagram or 3D rendition. This can be for almost any physical entity associated with the warehouse."[1] In other words, your digital twin is a fully virtual, simulated space encompassing the complete ins and outs of your warehouse. The warehouse simulations in this digital sandbox allow you to explore possibilities and build an ideal model of your operations.

Think of your digital twin as a sandbox for experiments. Bring a challenge or hypothesis to your sandbox and see what happens. Have labor challenges? See how automation could augment the productivity of a shrinking workforce. Curious about robotics? Add some autonomous guided vehicles (AGVs) to your shifts and see what happens.

Wondering if you can squeeze more inventory in your DC? Reconfigure your warehouse design and throw volume at it to see what happens.

These scenario tests could be the key to the evolution of your operations because you can build a business case and test it before asking for a single dollar. But not every digital twin is the same. There are varying degrees of capabilities and outputs.

When looking at these simulation technologies, keep these variables in mind:

Granularity: Digital twin systems can vary in the macro and micro-insights offered. For example, some systems simulate the performance of every headcount or material handling equipment (MHE) individually.

Integrations: Simulation systems test hypotheses, but by integrating ERP or WMS data you benefit from a true digital twin of your operations for more accurate analysis.

Scope: Typically, warehouse optimization is the primary vector for digital twin projects. However, some systems offer a wider view to include yard or transportation—which is beneficial when optimizing upstream and downstream operations for tighter logistics overall.
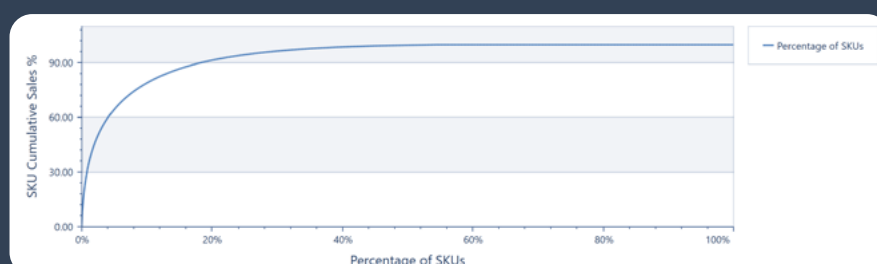
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1.   Gartner "Innovation Insight for Digital Twins in Warehousing, Dwight Klappich, Benoit Lheureux, 6 February 2020

An option to import your WMS data allows the simulation to reflect the actual product locations in your warehouse. This reduces the amount of data crunching needed.

SKU sales by aisle
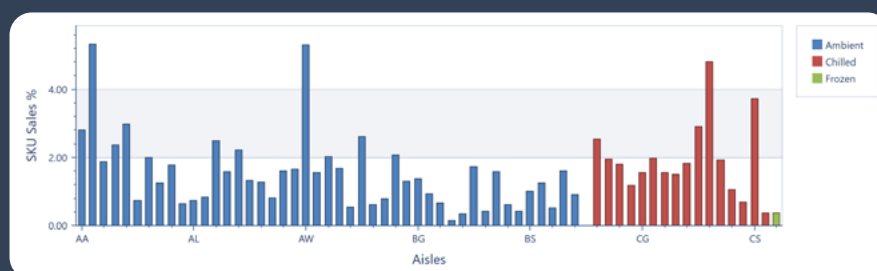
SKU cumulative sale, %

Digital twin: business value

Through a digital twin, warehouse simulation allows you to analyze the strengths, weaknesses, and opportunities of your resources. This includes the people, processes, and systems composing your operations. This helps in evaluating existing resources and strategies as well as when you're considering new technologies or approaches to your operations.

Key applications of digital twin systems include:

Space requirements and warehouse design
With a digital twin, you can analyze the strengths and weaknesses of your physical space to determine capacity. Maybe you can optimize space for more SKUs. Maybe you need to invest in a new distribution center (DC) or partner with a 3PL due to space constraints.

Some parameters include rack configuration and height; configurable warehouse dimensions; aisle width and orientation; bay and yard placement; automation placement such as palletizers and conveyors; MHE charging stations, and more.

Technology capabilities and processes
Earlier we mentioned how digital twin simulations can incorporate processes and data from the WMS or other systems. This is critical when examining your processes. But, digital twin systems offer additional operational logic. For example, they can understand the travel and acceleration time of manned and unmanned MHE, such as forklifts and automated guided vehicles (AGVs). It might seem like minutiae, but these details matter at scale. This allows you to achieve a more exact operational picture, and therefore make better decisions.

Workforce analysis and processes
With the labor challenges many businesses face today, having a tool to analyze performance and explore how to best utilize a shrinking staff or temporary workers can help you do more with less. With your digital twin, you can examine optimal headcount per shift, peak performance windows, and opportunities for workers to work with supporting systems such as voice technology or AGVs. This goes for picking, put-away, replenishment, and virtually any other job. With labor management system (LMS) data, you can recreate real worker shifts. This helps discover training gaps and identify top and bottom performers.

Network optimization
If you're trying to better serve customers across your distribution network, there's a component of simulation allowing you to analyze the capacity of your DCs against the demand of your geographies by building a digital twin of your network. This helps in selecting DC locations for your distribution network, 3PL partnerships, or understanding retrofitting needs for existing warehouses to meet customer demand.

The 2D heatmapping and animations highlight potential areas of congestion in your pickface.
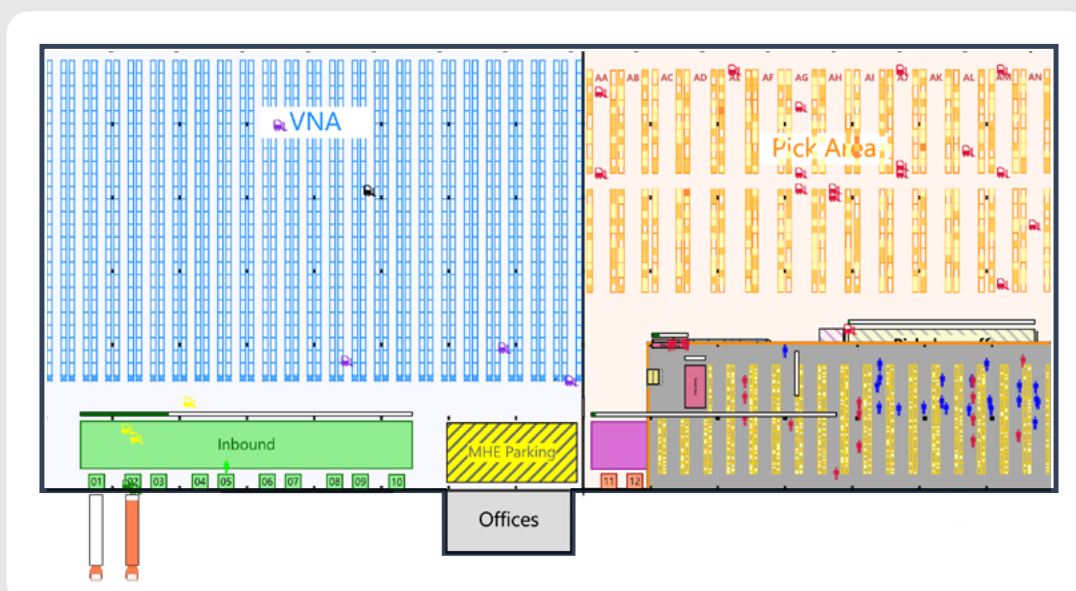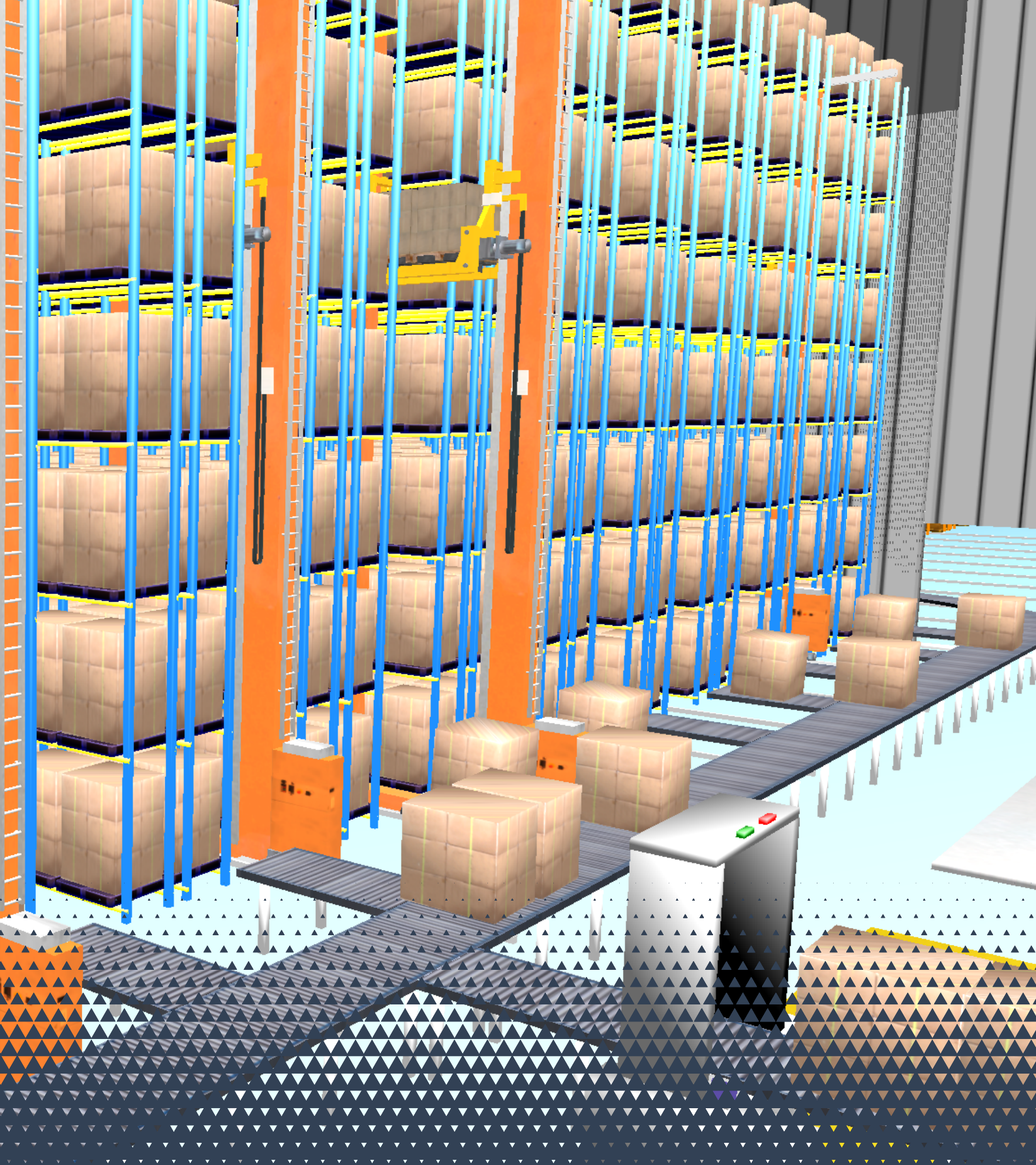
Modeling of various types of automation such as ASRS, miniloads, etc., allows you to consider different modes of operation as your business changes.

Digital twin: compared

Digital twin continues to gain popularity, but it's a relatively new option. Here we take a look at some of the other systems as a comparison.

Spreadsheets
Typically when using a spreadsheet to evaluate warehouse performance, you're dealing with averages. However, it's critical to understand the high and low points of your demand for resource planning and warehouse design. Planning for averages could leave you vulnerable during seasonal spikes, for example.

Another consideration is that a spreadsheet makes it hard to visualize your operations. Seeing the paths that are taken, hotspots, and bottlenecks from workers and MHE in a simulation helps determine the effectiveness of your space.

CAD
A computer-aided design is a great tool for modeling and configuring space. However, CAD does not offer operational insights offered through simulations. It won't put your data into motion to generate results. With a digital twin, stress testing is a core function— putting operational logic into motion. Digital twin systems often use CAD drawings for the modeling, then add the operational logic and simulation capabilities to the models. This allows you to design your warehouse in whatever technology works best and generate the data in a digital twin.

WMS & LMS
The data generated by a warehouse management system and labor management system is highly valuable to your business. By importing the data into a digital twin, you can see the data come to life visually. This makes it easier to discover the why behind your data. By integrating a WMS or LMS with your digital twin, you can more easily identify adjustments and find the right optimizations.

It's important to note that warehouse simulation technology may also be more accessible to your team compared to other tools. Some systems, such as CAD or even spreadsheets, will be as effective as the user's expertise. But, creating a digital twin can be handled by anyone with access to the software and enough operational knowledge to build a simulation. No coding, math expertise, or engineering degree required. This ease of use puts a powerful tool in the operator's hands without needing expert assistance to generate insights.

In order to be a true digital twin, the system needs to accurately recreate your warehouse— be it to test existing plans or to experiment with different designs and strategies. Drag & drop functionality and detailed specs for each component offer more accurate simulations.
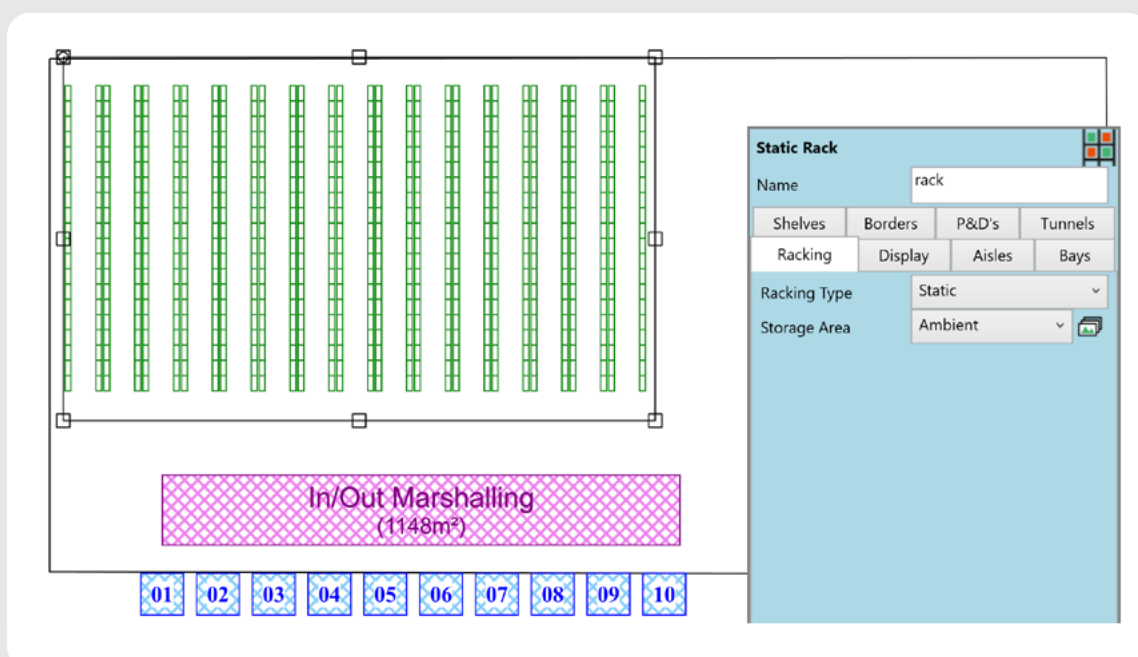
Digital twin: industry applications

Scenario testing in your digital twin offers proof points for your decision making. But, how does that apply to your specific market needs and challenges? Of course, you have the benefits of scenario testing mentioned earlier.

Let's look at how a digital twin benefits some industry-specific applications:

Third-party logistics
Proving (or disproving) the profitability of a new customer tender establishes the fit and overall potential of partnerships. But, speed is key. Building these evaluations needs to be done during negotiations. Taking too long to respond could damage a partnership, but short-changing your due diligence can strain your resources or lead to losses if the tender is a poor fit.

Because a digital twin calculates throughput and resource requirements for virtually any type of product, it's possible to generate an accurate model and throughput data to help evaluate the space and resource requirements for a tender. More importantly, this can be accomplished in hours and without outside consultants. This will help you understand if the existing DC can accommodate multi-tenant occupancy or if a greenfield DC would better support a new partner. Most of all, it puts valuable data in the hands of decision makers, making partnerships more strategic and profitable.

Retail
Because retailers exist in low-margin, highly competitive markets, finding efficiencies is key. "What if" scenario testing through a digital twin helps you understand gaps in processes, resources, or strategy. By testing different scenarios—such as different warehouse layouts to workforce optimizations, to bringing in additional technology or resources—you create a clearer picture for cost reductions and material flow. Building these warehouse simulations can also be a great way to prove out the need for additional resources, such as adding voice-directed technology, warehouse automation, robotics, or another supporting system.

3D visualizations of simulations help share your vision with customers and colleagues—offering tangibility for the data and hypotheses.
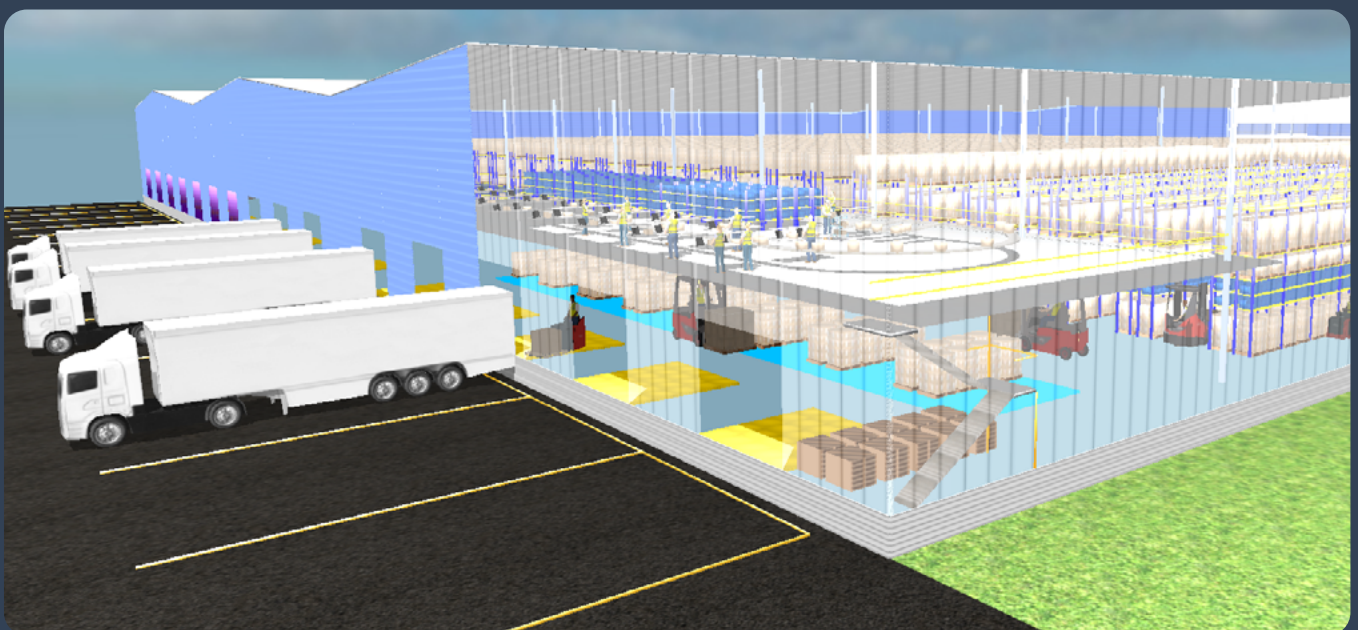
Manufacturing

With manufacturing, you need to strike the right balance between manufacturing output and the warehouse's throughput. A digital twin considers the factors of inbound materials from the warehouse, allowing you to understand how the warehouse can better facilitate smarter manufacturing. For example, if you're over-producing what a warehouse can move, that changes storage considerations. Maybe you throttle back on manufacturing if inventory sits on shelves too long. Maybe you add resources to the warehouse if demand necessitates more rapid throughput. Or maybe moving items within the warehouse reduces travel distances for picking and packing—leading to smarter operations. By looking at them within a digital twin, it's possible to configure proportional output for the manufacturing line and warehouse.

University & education

Digital twin systems made their way into colleges and universities, giving tomorrow's supply chain leaders the tools to help them build knowledge and best practices before joining the industry. As a safe, digital environment, running hypothetical warehouses teach these young professionals about the craft without suffering the hard lessons of trial and error on the job. As supply chain becomes more important to the health and profitability of businesses, the margin for error will continue to shrink. Warehouse simulation will help new generations of supply chain leaders make smarter decisions and gain critical experience.

Differences in activity across the day or week are easily accommodated in a digital twin simulation.
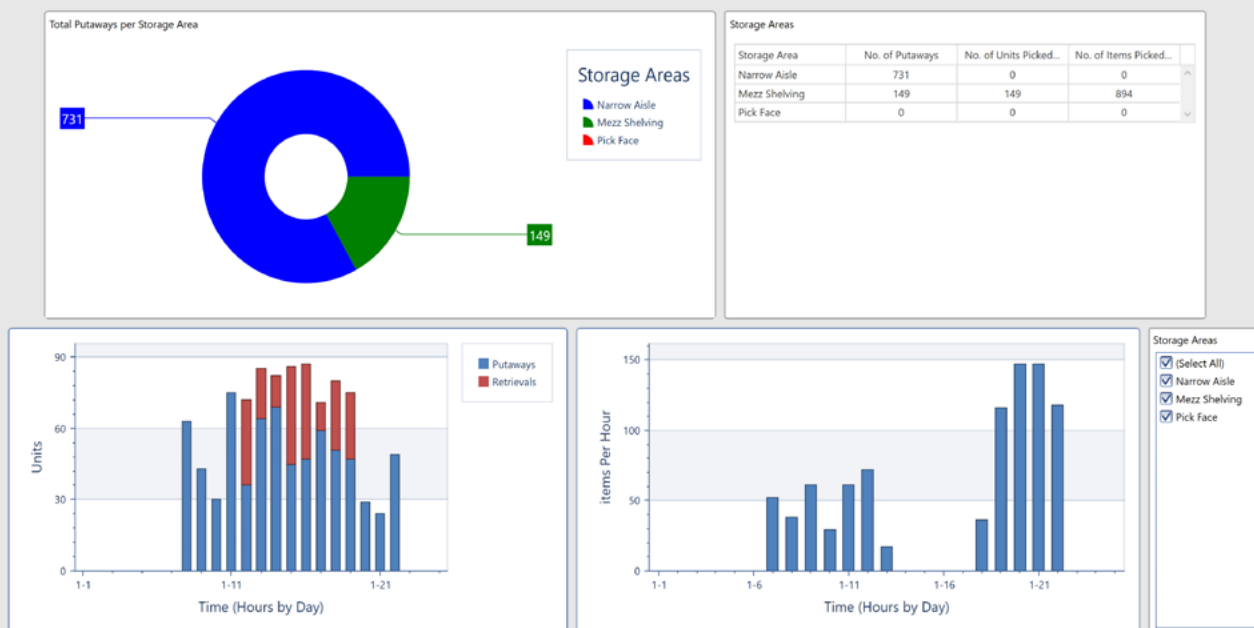
Digital twin: discovering your innovation

Knowing how important supply chain innovation is to the overall health of your business, how you make those choices matters. You wouldn't blindfold a surgeon or ask an accountant to guess payroll. So, why would you make decisions about your supply chain without the tools to be informed?

There's no replacement for experience. But, with rising complexity inside the four walls and in other areas of your operations, digital twin could be the missing link between today's challenges and tomorrow's innovation. By seeing scenarios play out within your digital twin, you generate critical data while understanding the context behind the data that builds confidence.

At a minimum, a digital twin helps you discover what works for the unique challenges of your warehouse layout, logistic configurations, and other critical factors impacting your operations. By removing uncertainty with warehouse simulations, discovering a path to improvement becomes less risky to the business while opening opportunities that might not have been explored otherwise.

View on-screen changes in real time and track parameters critical to your projects with digital twin simulations.
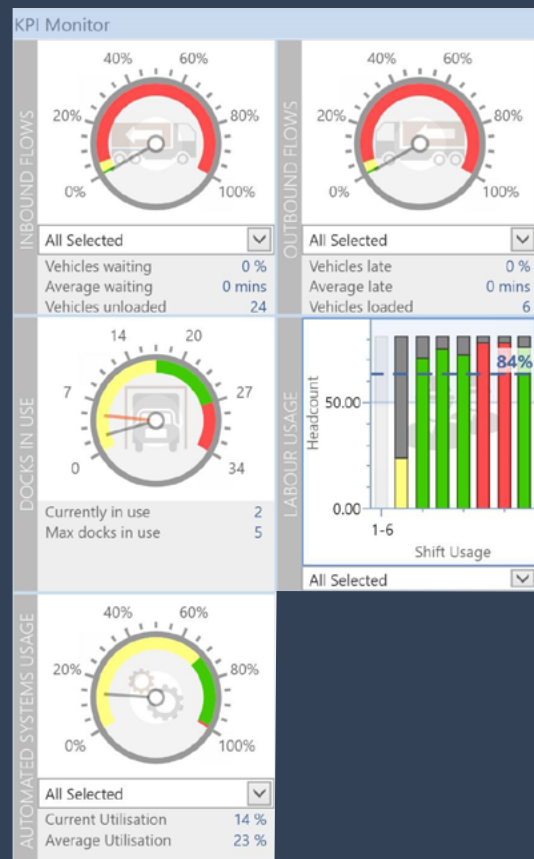
Comparing digital twin for warehouse design, planning, and simulation

	Ease of use	Operation logic	Operation simulation	Operational predictive diagnostics	Spatial awareness	3D visualization	Operation retro-diagnostics
Digital twin	✓	✓	✓	✓	✓	✓	✓
Spreadsheet	✓						
CAD	✓					✓	
WMS	✓	✓					✓
LMS	✓	✓					✓

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