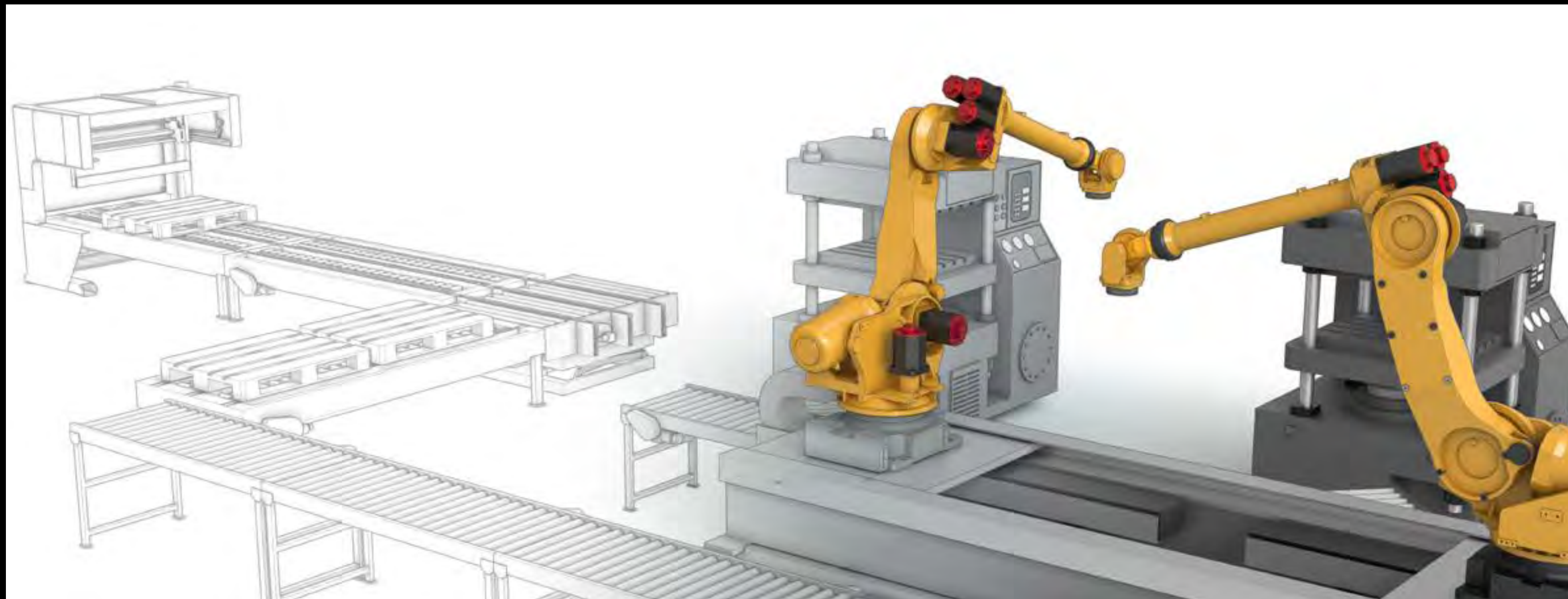




Why System Designers Choose Specialized Toolsets

A better way to design high-quality systems and factory layouts



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Introduction

Engineers who design production systems or work cells that go into plants, factories, warehouses, or other types of manufacturing facilities face a unique set of challenges that differ from those faced in typical product design processes. From planning the factory layout to construction and ultimately commissioning, there are seemingly endless contributing factors for missed deadlines and budget overages.

Ask many project engineers in this realm, and they'll tell you that traditional 3D mechanical CAD software simply wasn't built with the intention of designing and assembling large scale systems. So, what if there was a better way to plan and validate factory layouts?

In the same way that CRM and ERP systems replaced spreadsheets for a more tailored experience, specialized technologies are at your fingertips to supplement your existing CAD package with purpose-built factory design tools.

Top performing engineers are implementing these tools and adapting their processes in order to better meet the needs of their customers and deliver high-performing systems—quickly.





Mitigating risk in your projects

With tools that cater to your unique process and needs, you can reduce potential risks that can arise during system integration with large-scale design projects. But in order to reduce those risks, you must first understand where they come from.

Incomplete data

Imagine you're about to begin a new project. Your likely first step in the process is reviewing a specific set of requirements you've been given. But beyond these known requirements, there are always additional pieces of information you need in order to do your job well.

“What are my space constraints?” “What do I need to design around?”

These are the types of questions you must ask in order to fully understand the demands of your project.

Because the less information you have about your project's space constraints, the more likely something unexpectedly bad is going to happen once you start installing equipment in your facility.

Many engineers are accustomed to designing in 2D, but you can benefit from an accurate 3D representation of the as-is state of the building in order to prevent any surprises further along in your process. For example, if you're looking at a top-down view of your factory, there might be an area where you can't install equipment due to existing ductwork or piping, but that area might only exist ten feet off the floor. How do you account for spec information like that in a 2D drawing?

With specialized factory toolsets that connect your existing 2D design tool with things like parametric models and point cloud data, you can gain a more complete understanding of what you're designing around.

Inaccurate data

Just as important a question as “what do I need to design around?”—you also need to consider what the best way is to get the information that you need regarding your project’s space constraints.

Sketched out dimensions on a piece of paper might work well for a small backyard swing set build, but for large-scale design projects, you need a more robust option. Have you ever used a tape measure to measure the location of walls, beams, or pillars in a brownfield factory project? Or have you ever received measurements from someone else who took down measurements onsite for you? How much did you trust that initial set of data?

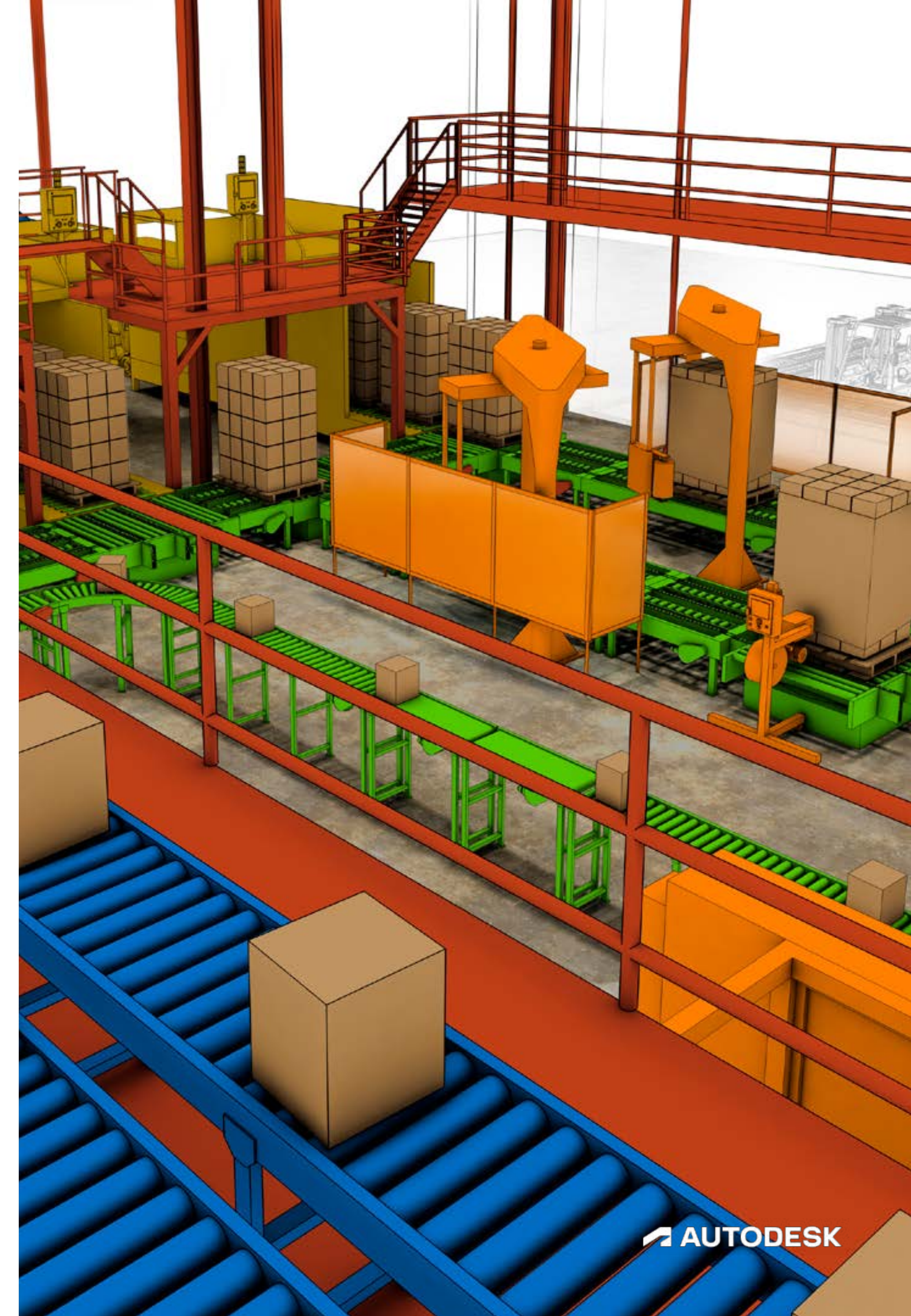
Collecting data manually is an invite for mistakes, which could lead to your entire project process stalling until you are able to collect the accurate information that you need. The best way to ensure the most accurate and complete collection of data for your project is to leave the pen and paper behind and create your factory assets in a digital environment.

Inefficient communication

Another huge factor contributing to risk in your factory design projects is whether everyone understands the process along the way.

Collaborating with your customers and other teams throughout your project has the potential to create misunderstandings that lead to someone approving a design that just isn’t correct. So how do you make sure your customers understand what they’re approving?

Comprehending a 2D drawing is a learned skill, and to the untrained eye it can be easy to miss small details. It’s also extremely difficult for non-engineers to understand how a stack of drawings all connect to each other. With additional capabilities like 3D virtual walkthroughs, you can facilitate faster approvals, make fewer mistakes, and spend less time communicating back and forth with your customers.





Impacts of risk

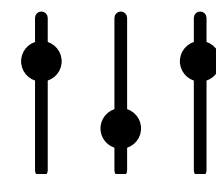
- Inefficient quoting process
- Cost overruns
- Client not understanding a design
- Missed due dates
- Unplanned project hours due to rework
- Installation issues
- Final product quality/performance issues

Benefits of designing with specialized toolsets



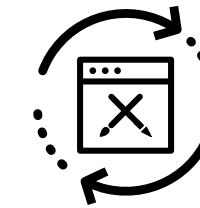
Confidently estimate or bid on projects

Create up-front concepts, including drawings, renderings and animations to support your documentation—with just the right level of detail to accurately scope costs and timelines.



Use insights to improve system performance

Visualize and evaluate system efficiency early in the process to make more informed design decisions.



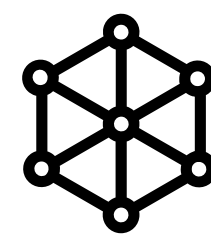
Design more productively

Build your model faster and with fewer errors by connecting tools that include capabilities specific to production system and work cell design projects.



Handover projects on time and on budget

Accelerate installation and reduce change orders by flagging potential issues early and planning and simulating construction sequences.



Collaborate more effectively with customers and colleagues

Everyone understands a virtual walkthrough, regardless of level of experience.

There's no sure way to eliminate any and all surprises from your production system and work cell design projects. But the best way to mitigate many risks is to use connected tools that share project data and include capabilities specific to the type of project you're working on.

Conceptual design

An oft overlooked yet incredibly helpful tool in your system design toolset is software that allows you to perform discrete event simulation. Discrete event simulation is a method of simulating the behavior and performance of a real-life process or system as a sequence of events in time.

When you're laying out a factory line or designing a work cell, it's extremely difficult to calculate bottlenecks without using simulation software. And running around with a stopwatch looking for ways to optimize your current process will only get you so far. The sooner you can simulate your process to identify bottlenecks, the less expensive it is to eradicate them.

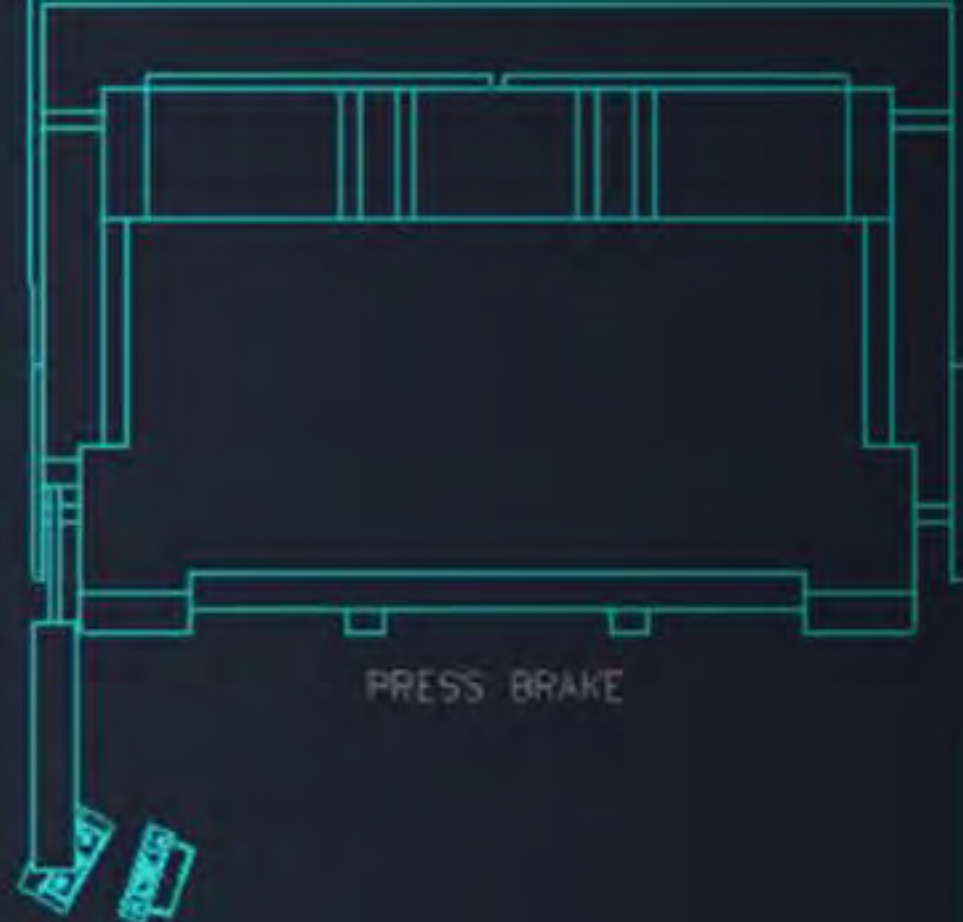
Discrete event simulation enables you to model, study, and optimize your manufacturing process at the concept stage, before you spend a ton of time plotting out your layout in your CAD software. By visualizing and animating your production process, you can better understand how your manufacturing process will really work, rather than how you've been assuming it will work.

For example, let's pretend you are designing a production line that contains five stations that are all making one part. You have run all the calculations for throughput, but does that include

regular maintenance or repair on the equipment that can sometimes cause bottlenecks in the system? By using discrete event simulation, you can test out different scenarios and equipment layouts to reduce bottlenecks and come up with a solution—from your desk.

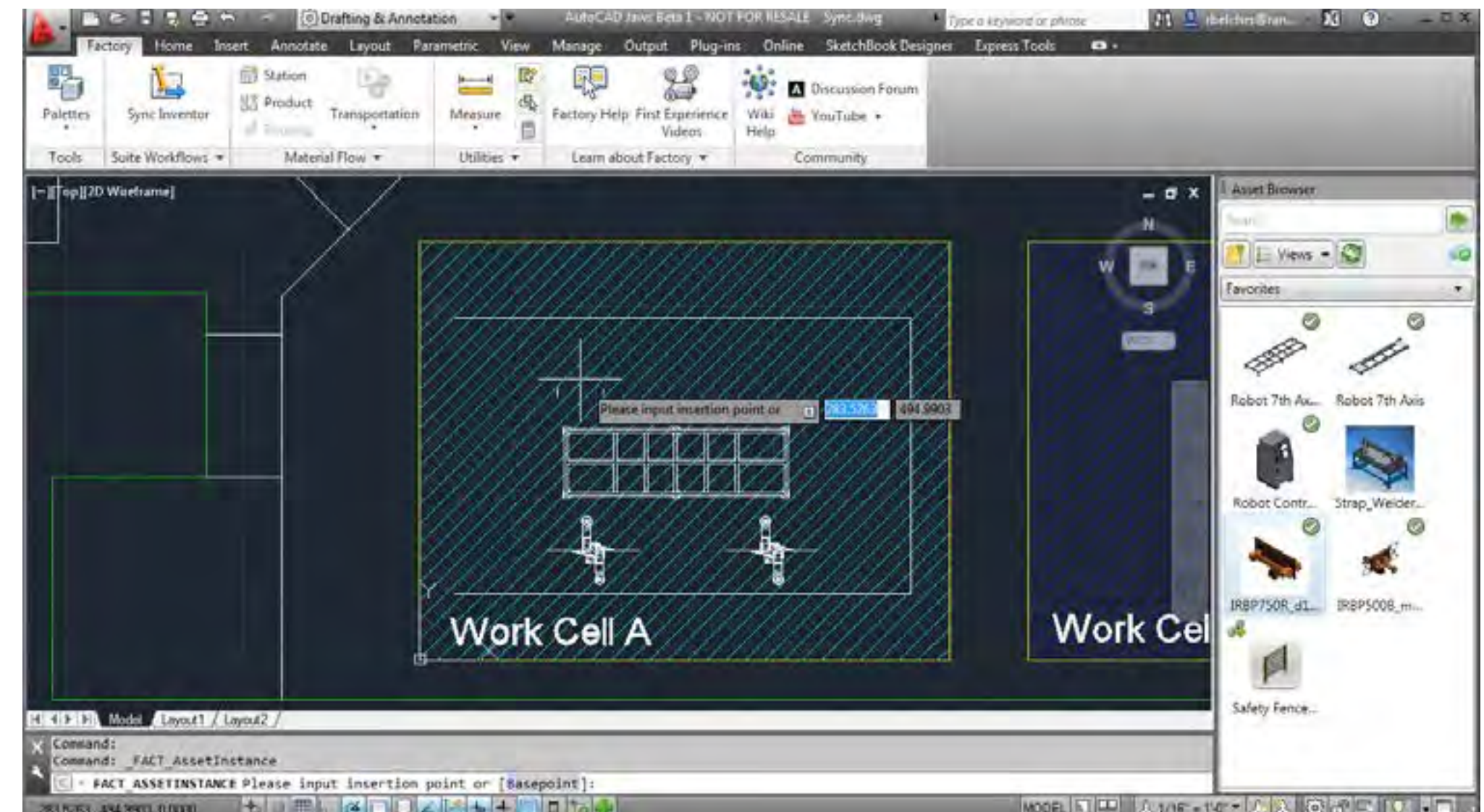
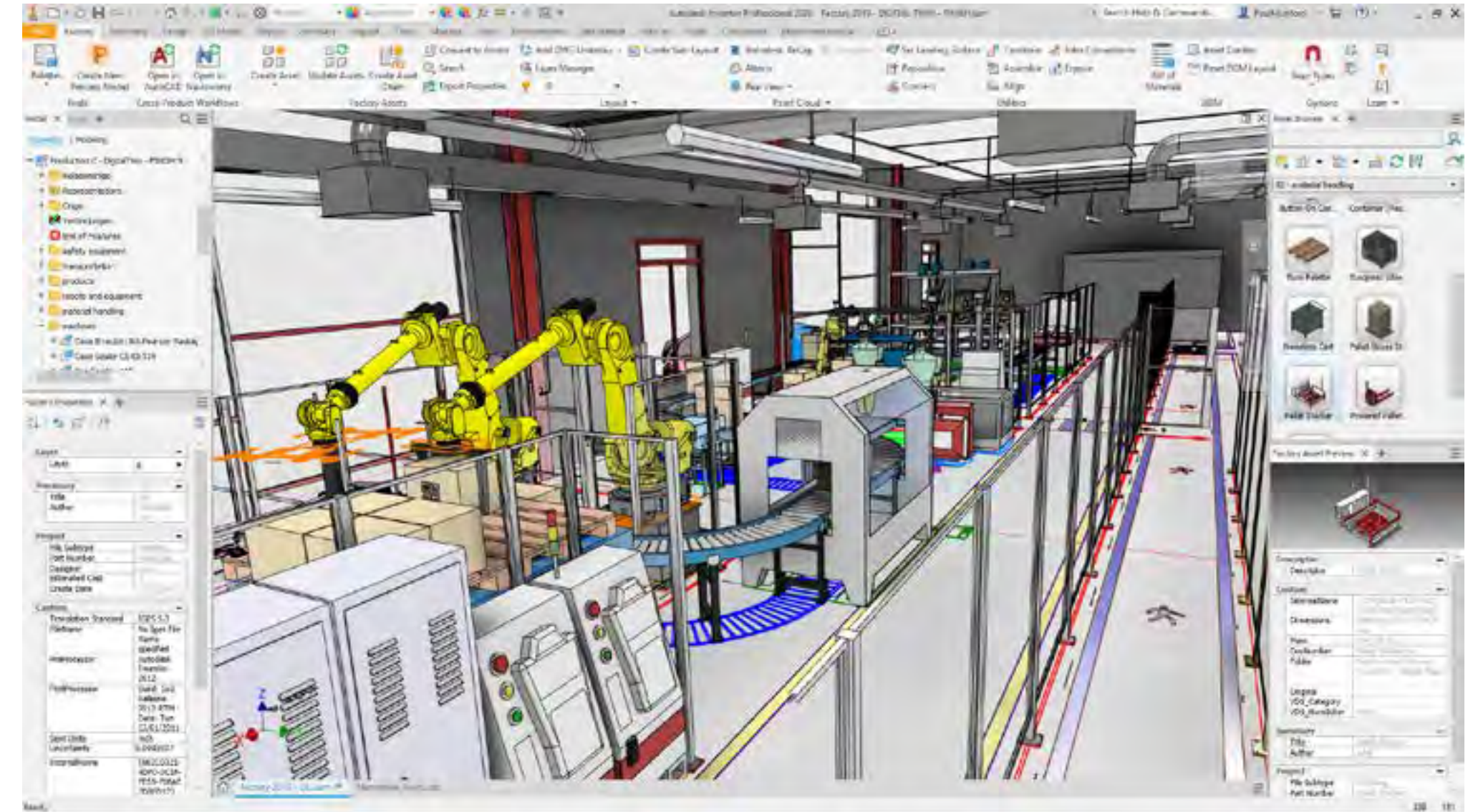
And testing your process in an application is fast and easy to change. Simply drag and drop your assets in and out of place, hit play, and observe where you need to make any adjustments to maximize throughput. When you determine that your production process is ideal, you can run reports on output and open your layout directly in your 2D design tool.

The sooner you can simulate your process to identify bottlenecks, the less expensive it is to eradicate them.



Leveling up your design process

Once you have an idea of the exact production process you need to design, it's time to start laying things out in your CAD software. You've likely been designing in 2D for years, but there are additional tools available to you that enhance your existing workflow. Specialized toolsets for factory design provide new capabilities that empower you to do your job better.



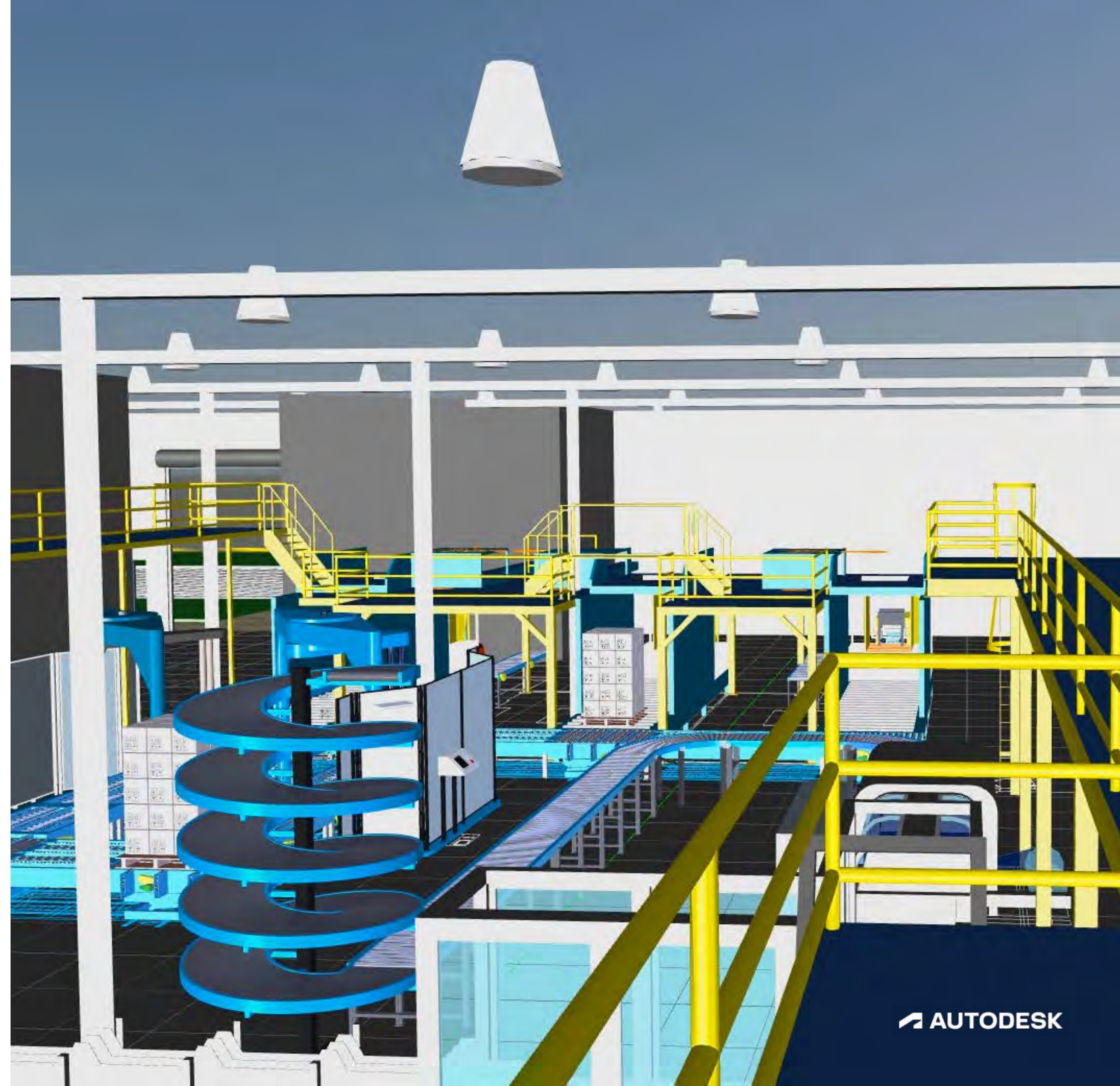
Design in 2D and get 3D for free

Factory design toolsets are purpose-built to help speed up your design process so you can get things done quicker. These tools help boost design productivity by connecting your existing design software with additional capabilities for 3D modeling.

Two dimensions work great for creating a layout, but you need three dimensions to see the vertical and fully understand the confines of the space you are designing your system for. Having a 3D representation of your layout helps visualize things like:

- Whether a box will actually fit through the space as it moves on a conveyor belt
- If there's an alternative way to design a piece of equipment to be closer to an electrical hookup
- If there's money to be saved by moving something an inch closer to an existing drain in the concrete

No one is asking you to change how you design. But with factory design toolsets, you can continue to design in 2D and get all the benefits of 3D for free. Conceptualize production line layouts easily using your familiar 2D toolset. Then, you can convert 2D layouts into detailed 3D models automatically, providing an extra dimension to inform critical design decisions.





Leverage a library of configurable assets

Once you've started designing with collaborative toolsets, you can reduce the time it takes to build a 3D model of your work cell or production line by authoring configurable equipment assets that can easily be inserted into your system layouts. You can then publish these assets locally to share with your internal team or upload them to the cloud and provide permission-based access for project contributors outside your firewall.

Add placement reference points to your model and publish it to the asset library. Your asset remains editable, and any automation configurations are preserved, allowing each instance of your asset to be configured individually. As you publish your 3D asset, a 2D representation is automatically created, or you can choose to add your own 2D drawing that represents your asset.

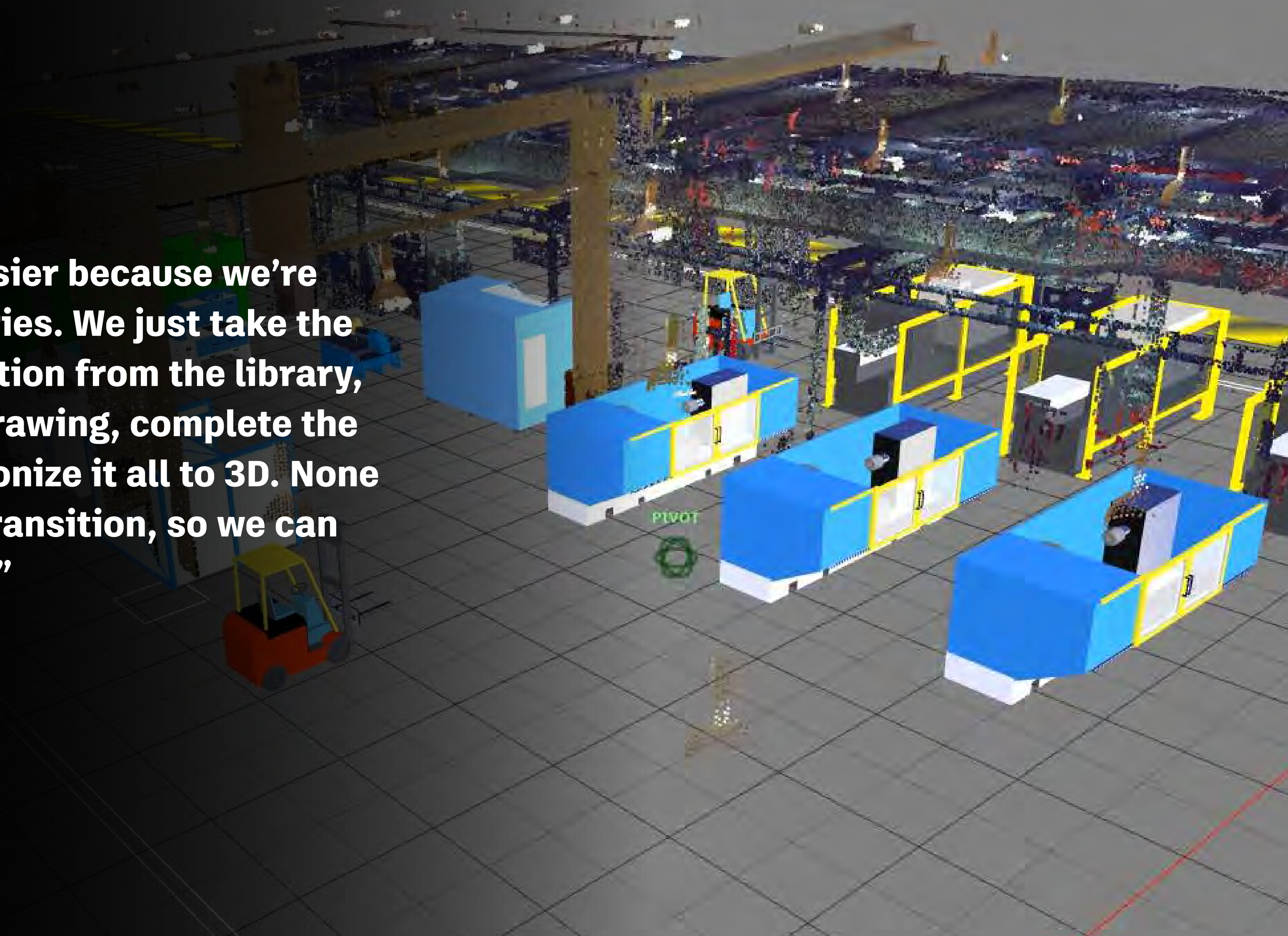
Library assets are bi-directionally synced between your 2D and 3D design tools. Quickly create 2D equipment layouts using your familiar 2D design tool. Then, automatically 'snap' assets together using your connecting points and make parametric changes. When you're ready to share your layout, you can sync to your 3D tool to populate the layout with 3D versions of your equipment assets.

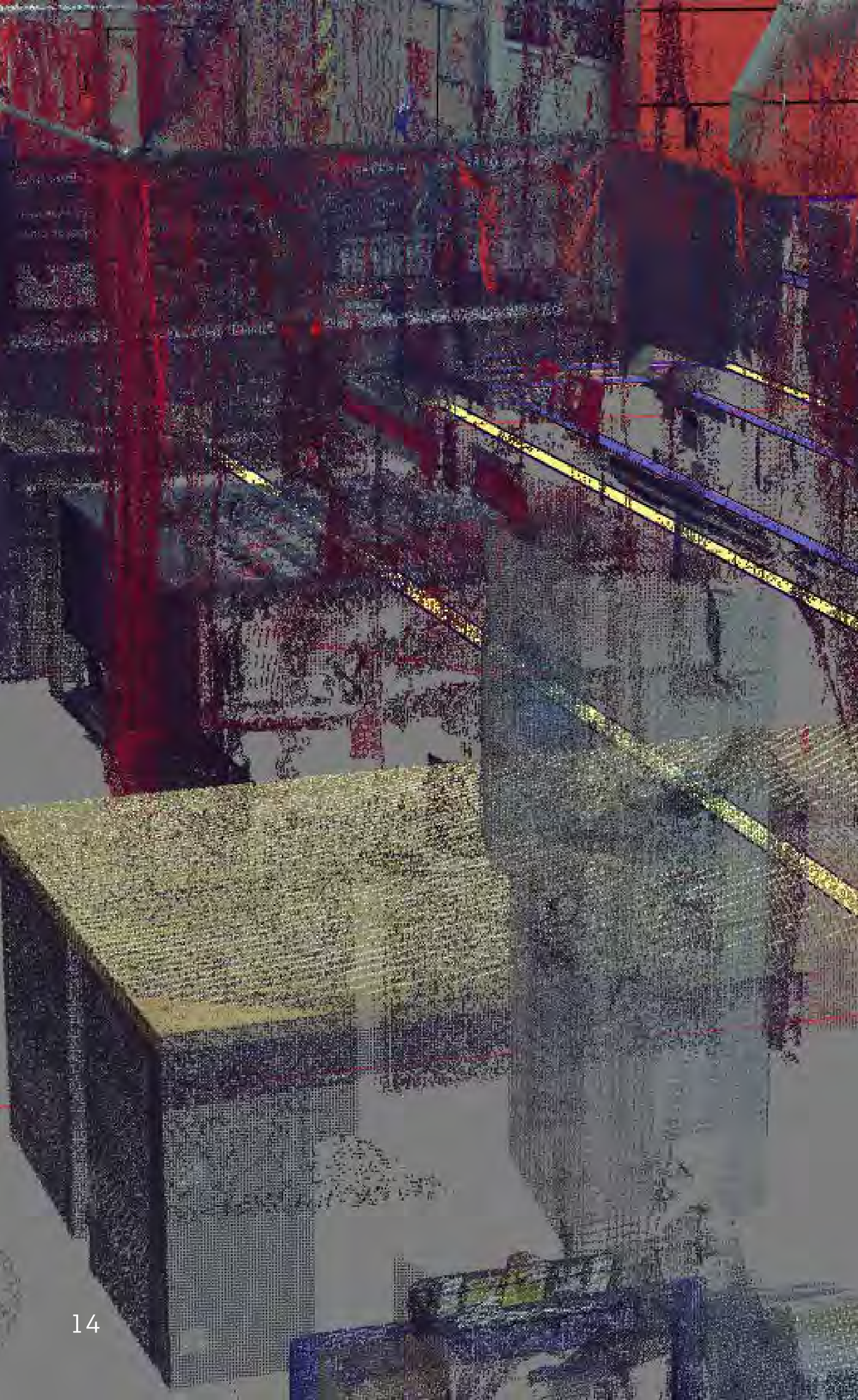
You can also build a configurator that uses the library assets you've created to provide alternative versions of your equipment. This allows you to swap in things like different types of motors, conveyors, workstations, bins, pallets, and methods of transportation, depending on the needs of a given project.

It takes time to establish your assets in your library, but once they're there, designing a line is as simple as placing equipment in your facility and connecting them with a conveyor or other material handling system.

“Now our work is much easier because we’re building a library of factories. We just take the 2D mechanical representation from the library, place them in the layout drawing, complete the configuration, and synchronize it all to 3D. None of our work is lost in the transition, so we can meet our deadlines faster.”

Assaad Hani
Business Analyst
Technica International





Beginning with a clear picture

Before you even start designing in 2D, you need things that can help you map out where you will place your equipment. Understanding an existing facility layout and conditions can be a challenge when planning new factory systems or work cells. Many facility owners don't have an up-to-date 2D drawing of their facility, let alone a 3D model.

The simplest way to get an accurate 3D model of the current 'as-is' state of your facility is with a point cloud scan.

Accurately capture the as-is state

A point cloud is a large collection of points acquired by laser scanners that create 3D representations of your existing facility. Similar to the types of survey equipment used by construction crews, getting a point cloud scan is as simple as setting up the

equipment in your facility and pressing a button, and the laser will scan everything that it sees. You can then capture different parts of your building, and the software will aggregate all your scans into one comprehensive point cloud that can be used inside of your tools for 2D, 3D, and simulation. You can even measure, markup, and run clash detections between the point cloud scan of your building and current production machinery and your proposed production line design.

Point cloud equipment is an initial investment, but it has the potential to save you a substantial amount of money in the long run by promoting problem-free installation.



Taking your models further

Once you have a 3D model, there are countless downstream activities that can give your design process a boost—all of which can be done faster and more accurately in 3D.

Perform virtual walkthroughs

Modern manufacturing facilities are complex, dynamic and difficult to visualize from a 2D plan. With 3D virtual walkthroughs of the planned design in the context of the facility, you can make it easy for non-technicians or people who are less familiar with reading 2D plans to see the future facilities as imagined by the designers, so they can provide critical feedback.

You can even use virtual walkthroughs for a high-level evaluation of ergonomics and space availability. All you need to do is put a virtual human in a work cell next to the equipment you've laid out, and you can see if there is enough space for them to accomplish what they need to do.

Spot potential clashes before installation

If you have an accurate representation of your building, you can analyze your layout for clashes and space constraints early in the design process. This helps make sure your layout will install properly and without delays, saving you time, frustration, and budget.

Manage the clashes in your factory layout by assigning them to members of your team. Clashes that have been addressed are automatically flagged as resolved and reports can be generated to show the progress. You can also simulate your project installation timeline to help identify sequencing issues that could occur while installing equipment on the factory floor.

Create installation documentation

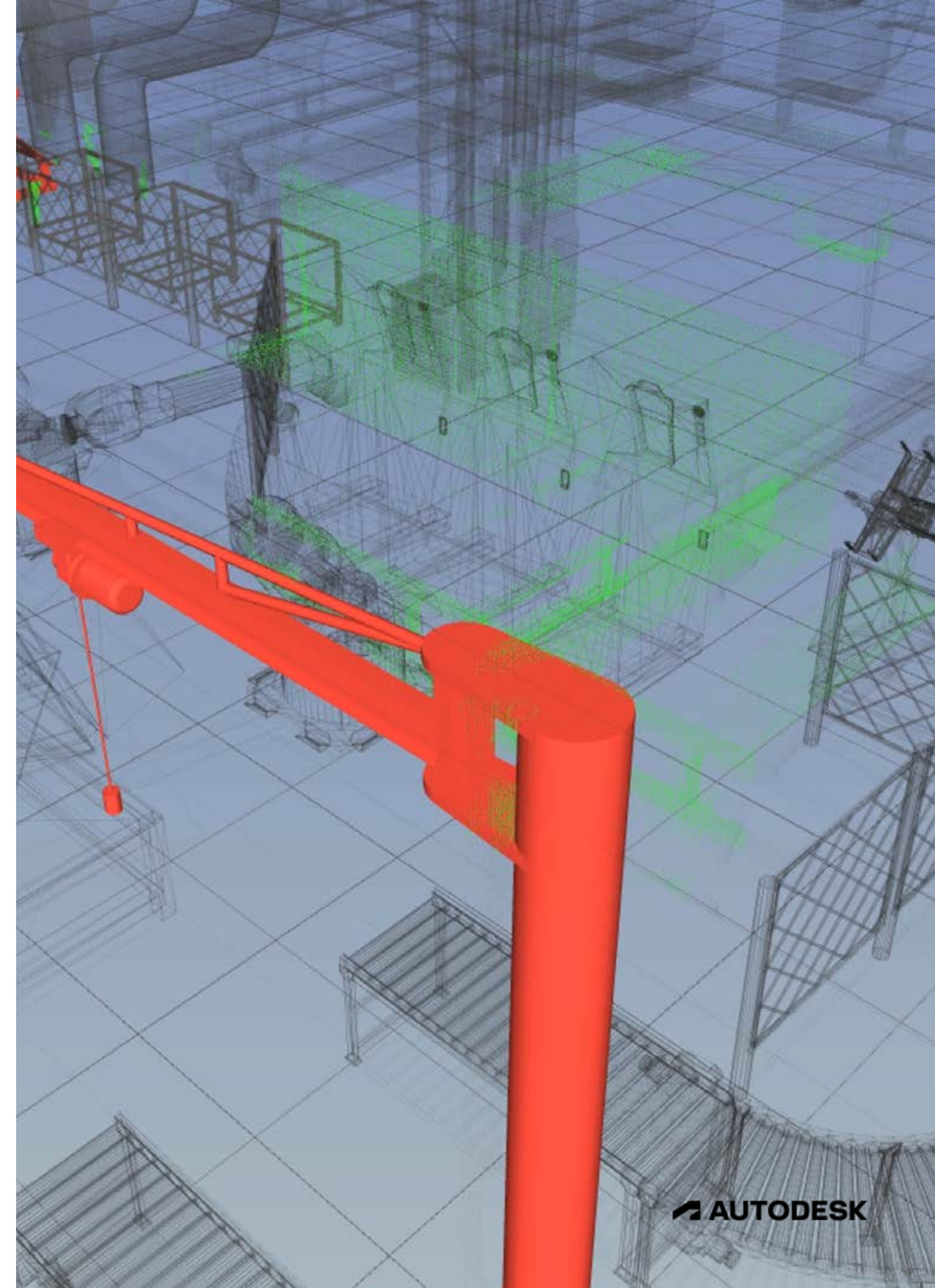
When preparing installation documentation of your model, you want people to have access to the latest release of your drawings to make sure they are working to the appropriate specs. With factory toolsets, not only can you quickly generate

installation drawings of your integrated factory model, including plan, section, and elevation views, you can also manage access and control release to make sure everyone is using the most up-to-date version of your model.

Deliver BIM compliant data

Building Information Modeling (BIM) is at the center for any given project in the architecture, engineering, and construction (AEC) industries. The overall facility is often managed as a BIM. Your goal is to deliver your production system as a model that is compatible and satisfies standards for your customer's BIM ecosystem.

Parametric 3D models usually contain a lot of detail which is great for manufacturing. However, the architect doesn't need all that information in their architectural design tool. Your CAD software will automate the process to quickly produce a simplified model and BIM project filetype in one easy to use tool.



“Using integrated solutions like the Product Design & Manufacturing Collection allows us to reduce our design time by half. We’re not repeating work, which is a big time savings. If we have standard projects that use components from the library, we can minimize engineering time as well. On top of that, we’re eliminating the risk of losing time correcting errors because we’re all using accurate data.”

Assaad Hani
Business Analyst
Technica International

Getting Started

Autodesk Product Design & Manufacturing Collection combines the powers of your familiar 2D toolset with the additional capabilities of 3D, providing an extra dimension to inform critical design decisions in the factory planning process.

Autodesk Factory Design Utilities is part of the collection—and contains purpose-built factory toolsets that seamlessly work together to help you minimize risk in your process and maximize system efficiency.

Ready to get started?

To learn more about getting started with Factory Design Utilities in the Product Design & Manufacturing Collection, visit our solution center.

[LEARN MORE](#)



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