

Taking the next steps towards your digital factory

A guide to implementing, using, and benefiting from digital twin technology in global manufacturing

Introduction

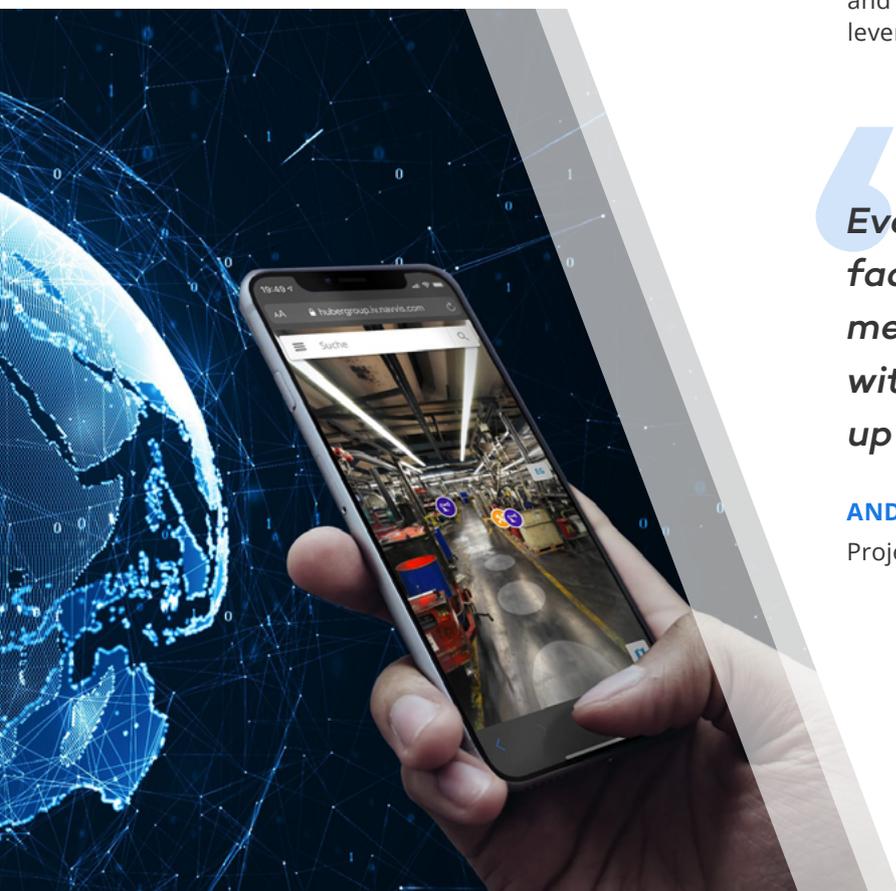
Manufacturing today must contend with fickle customers, overextended global supply chains, and shorter product life cycles. Enterprises in industries like automotive, fast-moving consumer goods, and chemicals must better anticipate these hurdles to prevent time sinks and costly pitfalls. And they're turning to digital transformation as the solution: a report by PWC states that 91% of industrial companies have already begun investing in digital factories at the heart of Europe¹.

Tracing a line of evolution that began with mechanical production and threads all the way through to mass production and automation, a digital factory offers enhanced interconnectivity between components, tools, production plants, and logistics centers. A digital factory brings together the strands of planning, communications, and operations to optimize the process of manufacturing.

The purpose of this guide is to explain the concept of a digital factory, the problems they can help to solve, and how to get started with factory digitization by leveraging NavVis technology and solutions.

“Even while in home office, our factory planners are able to take measurements in production halls without being there or even pick up a measuring tape.”

ANDRÉ BONGARTZ
Project Manager, Audi





Challenges facing manufacturing today

The situation today is that global production networks are increasingly widespread and complex. Coordinating centralized and local teams to manage these global networks is a real concern for many manufacturing enterprises, particularly OEM (original equipment manufacturers) and suppliers in the automotive industry.

In a rapidly changing, competitive marketplace, manufacturers are under more pressure to drive productivity, increase factory output, reduce quality costs, and decrease time-to-market. Three specific examples of the challenges they may face:

Shorter product life cycles

Whether it's an abundance of new car models in the automotive industry, the rapid turnover in seasonal collections in the textile industry, or the perpetual upgrade cycles in consumer technology, one common thread connects them all: the shelf life for manufactured goods are the shortest they've ever been. Consumer trends rapidly change from moment to moment. A reduction in time-to-market requires faster, more efficient assembly line changeover without increasing costs.

Greater product diversity

Simultaneously, consumer demand has shifted online and become more niche and specific, and product customization has become the norm. Let's look at the automotive industry as an example. It's common practice to have a standard car platform – a shared set of design, engineering, and production elements – to support multiple models and options. The volume of variants they must support continues to proliferate, even though the number of active platforms has shrunk in number².

Higher demand volatility

Supply chain disruptions can take many forms, for example, social unrest, or a new technology that initiates a paradigm shift in consumer habits, or pandemics like Covid-19 and beyond. It's clear that the ability to respond quickly and consistently across global operations is key to survival in turbulent times.

Each challenge brings into sharp relief the need for more transparency and flexibility in the manufacturing supply chain. As we progress through this guide, we'll structure our use cases around these two pillars: transparency and flexibility.

Part I:

How a digital factory transforms manufacturing

The promise of digitalization in manufacturing – a digital factory – is to address the challenges and bottlenecks in modern manufacturing, while also reconfiguring the production network into something that’s future-proof and adaptable.

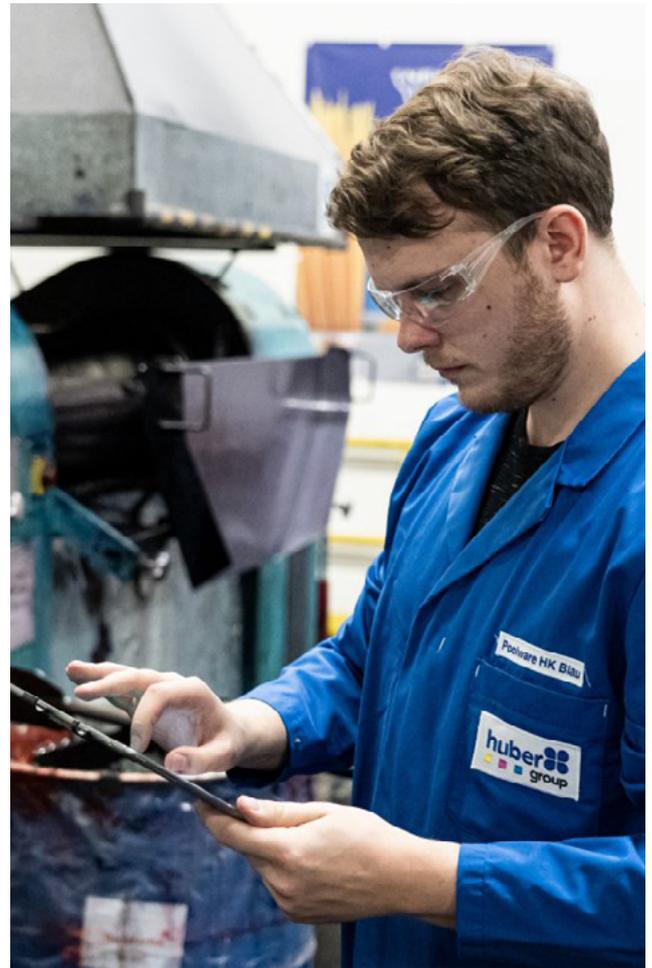
So what are the existing concepts in play? According to standard 4499 established by the Association of German Engineers (VDI)³, a digital factory is a generic term for a comprehensive network of digital models, methods, and tools – including simulation and 3D visualization – integrated into a continuous data management system. A digital factory's goal is for holistic planning, evaluation, and ongoing improvement of all the main structures, processes, and resources of a real factory in conjunction with the product.

The personnel necessary for a fully functioning digital factory are the same as those needed in an ordinary factory – operations managers, site managers, engineers, and operators. But their day-to-day tasks are routed through a single data environment customized for their specific needs.

Digging deeper, the definition of a digital twin offered by PWC in “Digital Factories 2020”¹ puts forward not one but three different kinds of digital twin for industrial applications

The three categories of digital twin:

- 1. Digital twin of the product:** A digital twin of the product is a digital representation of the product and links Engineering and Product Lifecycle Management (PLM) with factory operations. It is engineered as part of the R&D process and helps drive front loading in product development by making it possible to simulate and test the product at an early process stage.
- 2. Digital twin of the production asset:** A digital twin of one or more production assets is used for design, virtual startup, and ongoing operation. The focus is on simulating an asset’s operations, to set and optimize its key parameters and enable concepts such as predictive maintenance or augmented reality.



Day-to-day tasks in a digital factory are routed through a single data environment customized for your specific needs.

- 3. Digital twin of the factory:** The digital twin of the factory helps to plan, design, and construct the factory building and infrastructure. It can be used to support testing, simulating, and commissioning the building.

For our purposes, the last two sub-definitions – *a digital twin of the factory* and *a digital twin of the production asset* – are the primary areas addressed in this guide.

A digital twin of a factory isn't just limited to a single model, either. If production processes for multiple sites worldwide are virtually represented, it allows for global visualization of operating performance. Dashboards can visualize the data in real-time, for example, comparing different sites and identifying new insights and shop-floor improvements.

Digital twins, simulations, and the Industrial Internet of Things

Simulations and digital twins are sometimes confused as being the same thing because both can virtually replicate a production line or process. It's important to understand how and why they're different.

A simulation in computer-aided design (CAD) and engineering applications will approximate the operation of a real-world process or system over time. Simulations necessitate creating an "artificial history"⁴ for the model and introduce variables to see how the simulated system will react. Designers and engineers then try to predict outcomes for the operating characteristics of the real system it's supposed to represent.

In contrast, a digital twin is continuously updated and refined with real-world data – the history isn't artificial. All stakeholders can virtually monitor the operation of a production process and how it behaves in real-world conditions or reacts to unexpected changes. A simulation is static and used to test a supposition; a digital twin is active and reflects conditions as they are.

The key to collecting the data fed into a digital twin is an Industrial Internet of Things (IIoT) platform. IIoT is the term for the interconnected sensors, instruments, and other devices that are networked together with industrial computing applications, including manufacturing and energy management. This connectivity of IIoT is what allows for data collection, exchange, and analysis. And if used correctly, it leads to gains in productivity, efficiency, and time-to-market.

In tandem with an IIoT platform, the model becomes an integrated digital twin that can function as a business simulation tool, driving strategy at every stage. Also significant is how IIoT technology has simultaneously become more affordable and more sophisticated, making the creation of digital twins for the factory more financially viable.

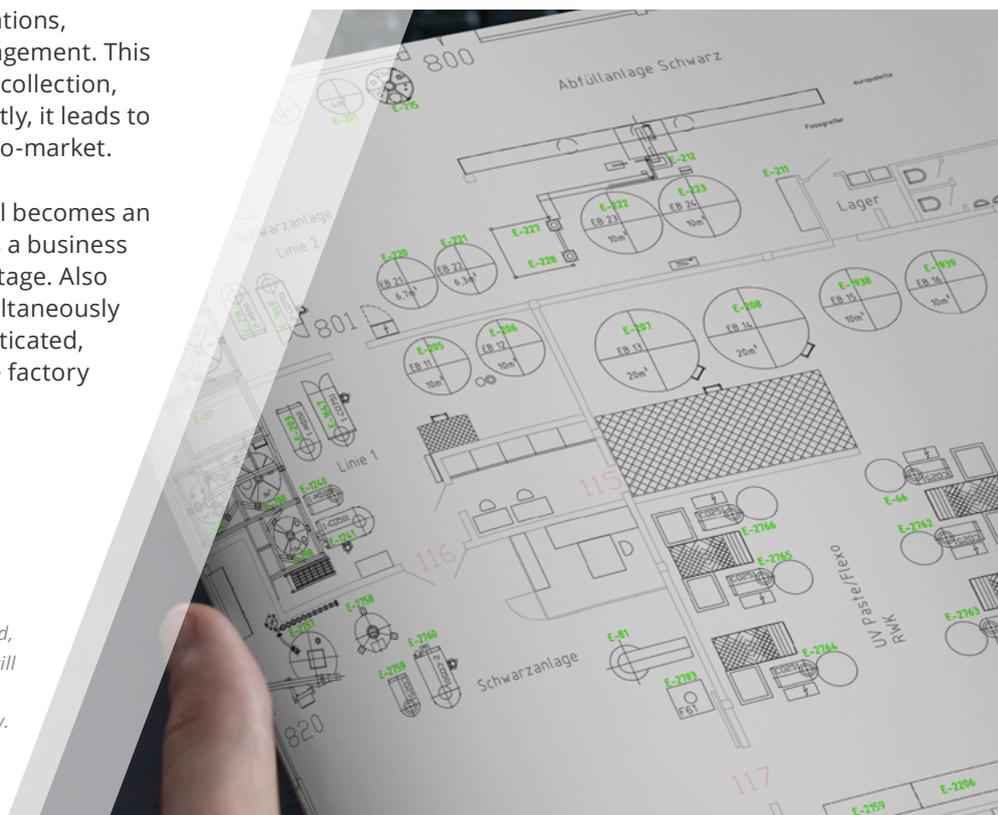
Factories are dynamic, and, over time, discrepancies will develop between the documentation and reality.

What's missing in current digital factory solutions?

Stakeholders need full confidence that each factory's digital twin reflects the brownfield conditions in their actual state. Factories are dynamic, and, over time, discrepancies will develop between the documentation and reality, making them something of a data silo for stakeholders.

For some, traveling to visit the factory in person is currently the only way to obtain the required detail and context of the actual brownfield conditions. And that becomes extraordinarily costly and time-consuming when you have a globally distributed factory network.

In practice, what's needed is a way to access, operate, and maintain accurate documentation for the "as-is" conditions of factory sites, forming the cornerstone of your digital factory network. Plus, the ability to interact with that information so that decisions taken in the virtual space are swiftly reflected in the physical.





Benefits of the NavVis Digital Factory Solution

As a single solution suitable for universal application, a NavVis Digital Factory Solution offers significant benefits for your entire organization, ranging from global operations and planning to the local factory shop floor. These include:

- **Lead-time reduction and faster go-to-market**
- **Reduce travel and increase productivity with online collaboration**
- **Reduce unforeseen costs driven by quality issues and planning mistakes**

In effect, your global team will enjoy unified operations, an uptick in best practice sharing, and a reduction in the need for extensive travel (contributing to a smaller carbon footprint and cost savings).

Meanwhile, local teams can apply the solution to repair and maintenance processes, 5S and Gemba walks, and as a visual master interface for a wide range of software applications.

By enriching the digital twin of a factory with customer-specific information and data at the correct location, for example, multiple workflows in the areas of operations, continuous improvement, industrial engineering, or maintenance receive a dynamic upgrade. Using the NavVis Digital Factory Solution, the benefits for enterprises quickly become apparent; increased transparency, improved remote collaboration, quicker decision-making, higher efficiency of workflows, and a reduction in travel cost.

Part II: The NavVis Digital Factory Solution

The solution to bridging discrepancies between the physical location and its virtual counterpart is terrestrial LiDAR, or 3D scanning. 3D scanning works by using a laser scanner on a tripod to collect measurements of the environment all around the scanning device, capturing the exact size and shape of the surrounding environment through the accumulation of billions of points. The resulting "point cloud" forms the basis for creating a virtual replica of a building or factory.

The use of 3D scanning technology for "as-built" documentation of factories is not new. Today it is used primarily by contractors on an individual project basis, e.g., before machine installation. But with the emergence of sophisticated mobile mapping systems, there comes a significant new development; the ability to scan at great speed and scale while still maintaining the required levels of accuracy.

Underpinning it all is a machine vision technology called SLAM (simultaneous localization and mapping), where specialized algorithms make it possible to record the "as-is" conditions of the site very quickly – up to 10 times faster than traditional tripod-based systems – and within very short windows of downtime.

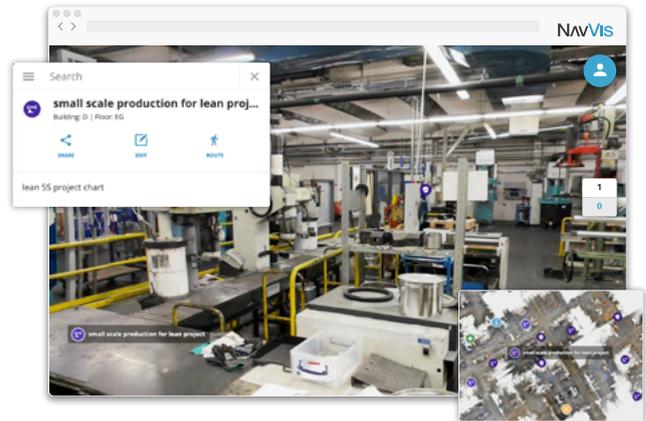
And with the use of web-based tools, which combine the simplicity of an interactive map with the accuracy of a surveying tool, stakeholders can navigate through their fully immersive digital 3D buildings to compare manufacturing concepts and take measurements as though they were there.

Moreover, this approach can be scaled and standardized. It's not just one specific high-priority project that benefits, but the entire production network. For instance, let's imagine that you had a vast number of poorly documented brownfield sites in your portfolio, scattered all over the world.

You're in the middle of a factory modernization project to address the challenges of shorter product life cycles, volatile demand, and high product diversity. And there's pressure to quickly collect floorplans, measurements, and inventory from each location for integration. But finding information that's consistent and accurate is hindering your progress.

A big headache, right? But what if you could capture your factory environment with mobile mapping technology instead of having to measure it manually? The solution can be applied in a matter of weeks, resulting in greater transparency and flexibility.

With the NavVis Digital Factory Solution you can virtually visit the shop floor of any production site around the world, using a standardized interface you can access at any time, from any computer, tablet, or smartphone. And moving forward, every stakeholder can collaborate and make decisions using the latest 3D data based on the most accurate information.



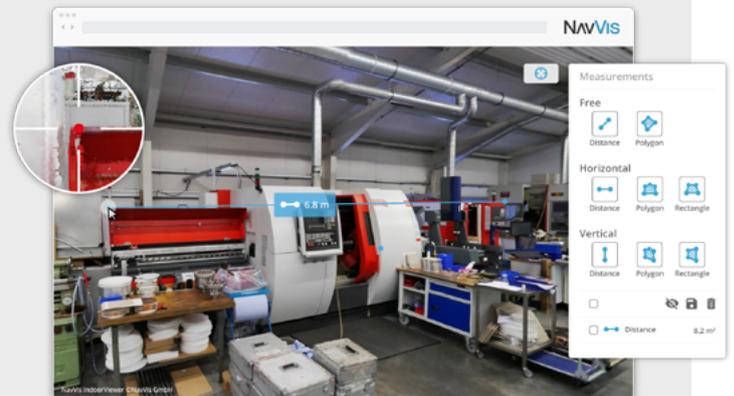
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The central hub of the NavVis Digital Factory Solution

The core enabler of the NavVis Digital Factory Solution is NavVis IVION Enterprise. This intuitive web-based application enables you to virtually access your sites from any device.

You can also import scan data from other sources like a drone or terrestrial laser scanner to create a single, comprehensive factory model. And users can crop and download sections of point cloud data for importing into third-party modeling software.

The strength of NavVis IVION Enterprise resides in how it makes vast amounts of "as-built" 3D documentation available to every hierarchy of your organization. Whether it's a routine site inspection or providing spatial context for industrial engineering and simulation tasks, factory digitalization at scale is now at your fingertips.



Whereas existing tools working with 3D data require specialist training, NavVis IVION Enterprise is a sophisticated web-based application with a refined user experience. Broader adoption throughout the whole organization is now possible, and you don't have to limit the use of your data to staff with a background in 3D design or engineering.

“My suppliers can easily get an understanding of what my factory looks like and what kind of solutions I need.”

THOMAS MEIER

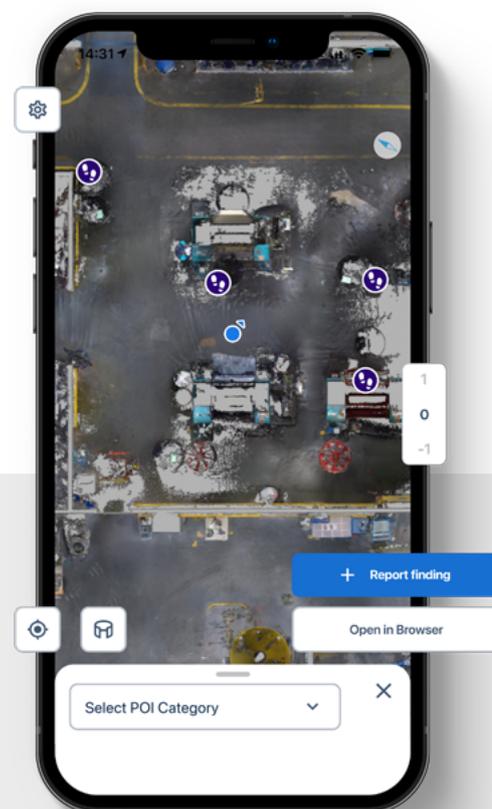
Senior Director Corporate Commodity Engineering -
Production Equipment, Siemens

**The mobile entry to the
NavVis Digital Factory Solution**

With NavVis IVION Go you can access your digital twin of the factory using an iOS or Android device, so that your production and maintenance teams on the shop floor can collaborate with team members using NavVis IVION Enterprise on their desktop.

You can add information such as Gemba walk findings, defects, and new ideas for improvements to the NavVis IVION Enterprise instance, and then share them with your colleagues by mail and messenger.

The power of NavVis IVION Go is to assign information to the precise location on the shop floor. Colleagues can easily search, find, and view the spatial context of this location before they ever go onsite, whether it's to repair machinery or conduct a health and safety inspection.



Over time, NavVis IVION Go reduces the need to be physically at the site at all, because the NavVis Digital Factory Solution provides remote access to the necessary contextual information from one place.

NavVis IVION Go makes use of our proprietary visual positioning and tracking technology. Unlike existing positioning solutions, the technology works with image data only, without the need for hardware infrastructure such as Bluetooth beacons or QR codes.

How mobile mapping is used to capture manufacturing facilities

Data capture with cutting-edge technology like the NavVis M6 or NavVis VLX mobile mapping systems enables a single technician to generate a complete, high-quality point cloud of a factory in a matter of hours instead of weeks.

- NavVis M6 is a fast, fully scalable mobile mapping system on wheels that can capture commercial and industrial environments at the speed of walking.
- NavVis VLX is a first-of-its-kind, wearable mapping device that brings high-quality reality capture to industrial environments in a versatile, compact design.

This service is made possible by our network of highly qualified local scanning partners certified in the use of our next-generation laser scanning devices. After that, the rich 3D data of assembly lines, machines, and building infrastructure is made easily accessible from any standard web browser via NavVis IVION Enterprise.

Compared to existing 3D scanning solutions, the NavVis M6 and NavVis VLX offer extremely fast data capture – up to 30,000 sqm per day – while still maintaining accuracy in the millimeter range.

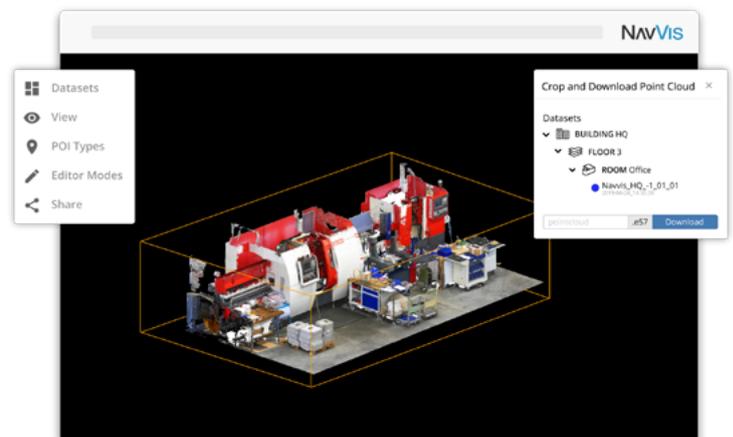


Greater emphasis on flexibility and transparency

Let's dig a little deeper into how the NavVis Digital Factory Solution can bring more flexibility and transparency to the production network, looked at through the prism of six use-cases.

Increased flexibility in production network

- 1. Global manufacturing and footprint optimization.** NavVis IVION Enterprise enables Global Operations Managers to virtually inspect, take measurements, and compare different production sites worldwide, all from within a web browser. They can remotely evaluate machines, tools, and even entire factory layouts. Thus empowered, they can quickly make qualified decisions without the need to be physically onsite, making substantial savings on time and travel.
- 2. Planning layout changes and equipment installation.** With NavVis IVION Enterprise, Assembly and Factory Planners have a powerful and easy-to-use tool to plan their assembly line changes and equipment installation. They can crop and download specific sections of a production line, for example, and send their selection directly to the relevant teams. In turn, they can import it to third-party CAD, PLM, and VR (Virtual Reality) applications for modeling and simulation to quickly verify layout concepts. In this way, stakeholders can plan changes more reliably, avoiding costly planning mistakes and delays in implementation.



With NavVis IVION Enterprise, users can crop and download specific sections of a production line and import it to third-party CAD, PLM, and VR (Virtual Reality) applications for modeling and simulation.

Increased transparency

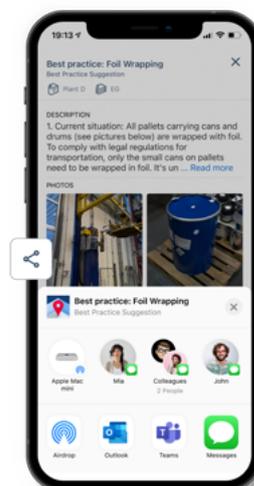
- 3. Best-practice sharing.** NavVis IVION Go empowers any employee to submit new proposals and ideas directly from the shop floor, with just a few taps on a smartphone or tablet. Reviewing these proposals with NavVis IVION Enterprise, the Continuous Improvement Manager better understands the proposal in the context of its exact location and surroundings. In addition, CI Managers can use NavVis IVION Enterprise as a visual tool to document their best practice initiatives globally. They can share locally established solutions for implementation throughout the international production network. Because this spatial information makes best-practice propositions easier to understand, the net result will be increased adoption, greater standardization, cost savings, and worldwide product quality improvements.
- 4. Visual interface.** Integrate different platforms into NavVis IVION Enterprise for a centralized, location-aware data access point. Display relevant information from other systems such as KPIs, MES, or sensor data to a given machine or process at the location where it is situated. Geo-tagged points of interest can present information as documents, images, videos, and more, making it simple for every stakeholder to access and share knowledge throughout the company.
- 5. Defect reporting and maintenance.** With NavVis IVION Go, personnel can report a defect direct from the shop floor with essential details including its exact location, description and photos of the issue. NavVis IVION Enterprise can integrate asset management and maintenance workflows so that personnel can view up-to-date asset management information – including location and documentation – to streamline maintenance processes. Using the photorealistic, geometrically accurate data in NavVis IVION Enterprise, technicians can quickly locate an asset in advance of their site visit. Now familiar with the machine and its surroundings, they can better prepare for a task with only the equipment necessary.

- 6. 5S and Gemba walks.** NavVis IVION Go supports Team Leads and Shop Floor Management in their daily walks. They can document findings with a smartphone or tablet and review the status of findings from previous walks. The auditor can share their findings with NavVis IVION Go from the shop floor using their preferred mode of communication. Management can review these findings with NavVis IVION Enterprise either individually or together in a meeting.

Besides those applications focused on internal use, virtual tours with contractors and clients also help reduce overheads for facilitating external personnel's presence on-site, mitigating risks for both visitors and production.



Display relevant information and KPIs from other systems such as MES or sensor data to a given machine or process at its exact location.



The NavVis Digital Factory Solution enables the optimal collection of ideas and documents; best practices are assessed from within their spatial context, and can be shared with team members or between production sites.



Part III: The building blocks of a NavVis Digital Factory Solution

The NavVis Digital Factory Solution provides manufacturers with the most seamless and powerful way to implement and operate a digital twin of their entire indoor factory space.

Transforming multiple factory workstreams, leading global manufacturers across numerous industries use NavVis technology to visit production sites remotely, collaborate with others, and use our comprehensive and highly detailed point clouds for planning tasks.

So how to begin? Integral to the NavVis Digital Factory Solution is that we offer a rapid and cost-efficient service to digitize and continuously update the “as-is” state of factory buildings and equipment in 3D for entire global manufacturing networks.

The process in three steps:

1. First, we determine how digital twin technology can best serve your team – globally and locally – during the **consultation** phase.
2. Next is data capture: we leverage our global network of certified mapping partners to **scan your factories**, wherever the location.
3. The net result is a **secure, cloud-hosted virtual site** of a subset or all your factories that can be accessed using a web link on any standard web browser.

And looking to the future, the vast quantity of rich 3D data at your disposal presents a valuable opportunity for future applications such as AR (Augmented Reality) use cases on the shop floor, leveraging the unique visual positioning technology from NavVis.

Wrapping up

This guide has outlined how the NavVis digital factory twin can speed up the decision-making process for global operations. It brings lasting benefits with high-level standardization, greater flexibility, and faster optimization in production. Plus, manufacturers can eliminate the need to travel and strengthen collaboration between local experts and central departments like health and safety, industrial engineering, continuous improvement, and more.

Eager to learn even more about how to implement, use, and benefit from digital twin technology in manufacturing on a global scale? The specialists at NavVis are ready to take your call and continue the conversation.

About NavVis

Bridging the gap between the physical and digital world, NavVis enables service providers and enterprises to capture and share the built environment as photorealistic digital twins. Our SLAM-based mobile mapping systems generate high-quality data with survey-grade accuracy at speed and scale. And with our digital factory solutions, users are equipped to make better operational decisions, boost productivity, streamline business processes, and improve profitability. Based in Munich, Germany, with offices in New York and Shanghai, NavVis has customers worldwide in the surveying, AEC, and manufacturing industries.

For more information, visit www.navvis.com.

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Using the NavVis Digital Factory Solution, stakeholders can navigate their global manufacturing assets using any laptop, tablet, or smartphone.

“Thanks to NavVis technology, every SKODA AUTO employee worldwide can collaborate and inspect the most up-to-date virtual representation of the production floor, reducing costs and time-to-market.”

LEOŠ ČERVENÝ

VR & Digital Factory IT Lead, SKODA AUTO



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**NavVis is the global market leader in
indoor spatial intelligence technology
and enterprise solutions.**

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