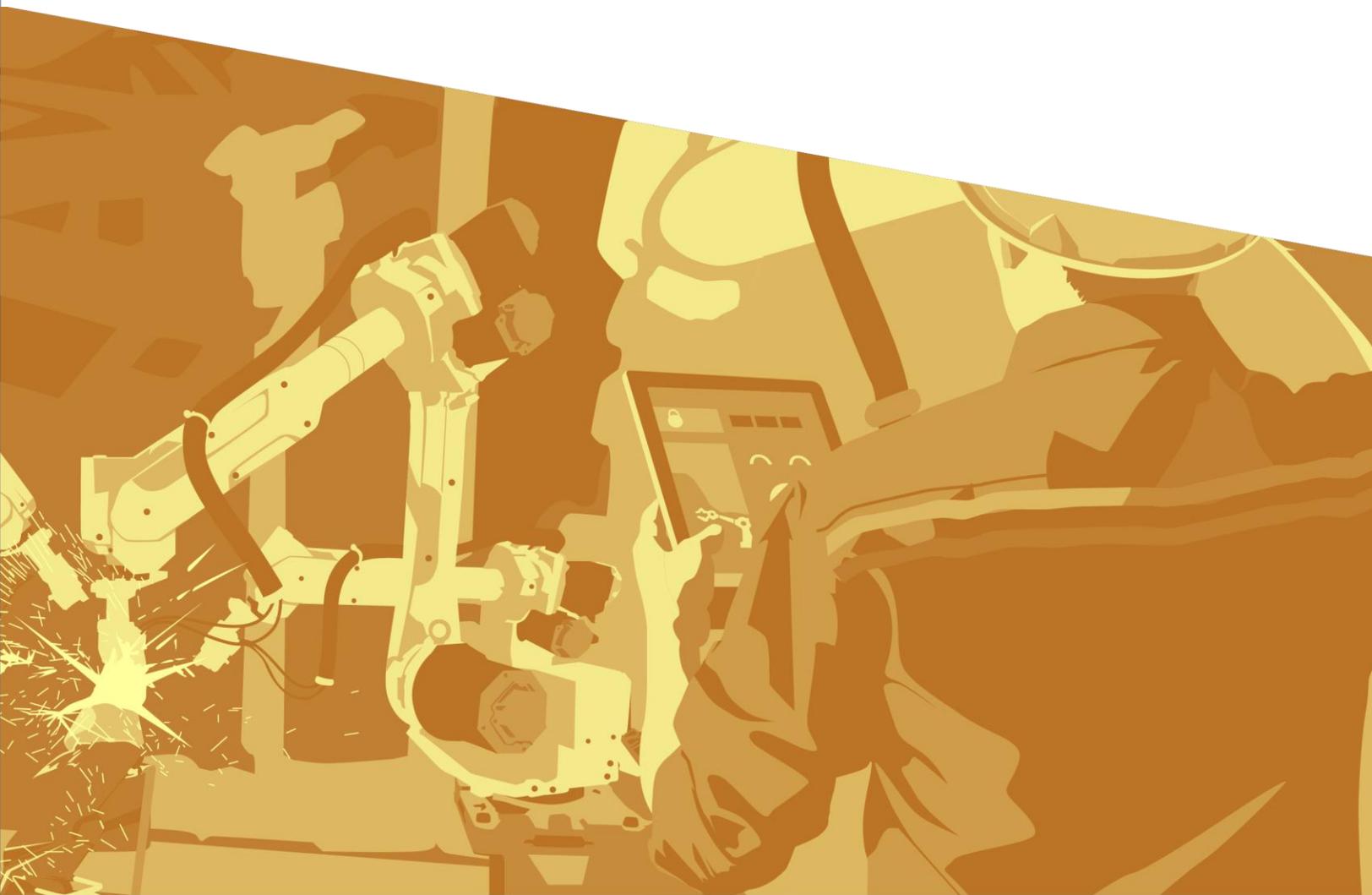


REALIZING VALUE FROM DIGITAL TWIN INVESTMENTS IN MANUFACTURING

STRATEGIES FOR SUCCESSFUL DEPLOYMENT

LIFECYCLE  INSIGHTS





EXECUTIVE OVERVIEW

Over the past few years, manufacturing and operations organizations have been hard-pressed. Disruptions in many forms, ranging from the pandemic to supply chain challenges, have made it harder than ever to manufacture goods. Going forward, these difficulties show no sign of abating, and many new problems loom on the horizon.

Despite these troubles, company executives still assign aggressive targets to manufacturing and operations leaders, and they must deliver high-quality products on time with the same or fewer resources. Many such manufacturing and operations leaders realize they can't keep doing things the way they have in the past. New approaches that help achieve these burdensome requirements are warranted.

As a result, many of these manufacturing and operations leaders are turning to digital transformation initiatives. These improvement efforts rely heavily on powerful, novel technologies alongside personnel and process change. One crucial aspect of these initiatives is the manufacturing and operations digital twin: a comprehensive digital model that predicts, mirrors, and matches the operations of a production environment.

While such initiatives are appealing, organizations must be careful. Realizing value from digital transformation and digital twin initiatives requires more than just installing software. Manufacturing and operations leaders must actively drive alignment amongst teams, clearly define roles, responsibilities,

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and processes, and manage the transition from the old way to the new way of doing things.

This report guides manufacturing and operations executives on all of these topics and more. The contents of its sections are as follows:

- The *Drivers of Change* section details the issues pressuring manufacturers to improve manufacturing and operations. The nuances of these different topics set the context for the goals they hope to achieve.
- The *Enabling Methodologies* section focuses on the ways companies use digital twins across three critical production phases. This section shares the key characteristics of digital transformation initiatives that deliver value.
- The *Successful Deployment* section shares best practices in pursuing a digital twin initiative, helping organizations navigate the complexities of personnel, process, and technology change in a digital transformation effort.

Today's manufacturing and operations leaders are indeed faced with immense challenges. However, pursuing digital transformation and digital twin initiatives in the right way will allow them to meet and overcome such difficulties.

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DRIVERS OF CHANGE

Today's manufacturing and operations organizations are considering different digital transformation initiatives for a wide variety of reasons. Certainly, manufacturers are being tasked to do more with less. But there are also specific drivers of change that are pushing new implementations and deployments. Organizations are looking to:

- adopt sustainability and carbon footprint reduction processes,
- support reskilling for workers while also ensuring safety for those workers on the factory floor,
- enable more flexibility and resilience in the face of business disruptors, and
- deliver the right products to market faster.

This section explores these different drivers and how a manufacturing and operations digital twin can help companies better address them.

SUSTAINABILITY AND CARBON FOOTPRINT

A good portion of all global carbon emissions can be attributed to manufacturing, operations and production, so it's no surprise that manufacturing and operations organizations are facing pressure to dramatically decrease their carbon footprints. Consumers, investors, and governments are all demanding a high level of sustainability from companies. But many companies have another reason to do their part to combat climate change: They recognize that building solid sustainability practices can give them a competitive advantage in the market. For these reasons, many manufacturing and operations organizations are adopting digital transformation technologies like digital twins to monitor and reduce their carbon emissions.

There are two key areas where manufacturers can make targeted sustainability improvements: operations and supply chains. To improve sustainability in operations, manufacturers need accurate tools to measure their existing carbon footprint across the entire production process. They need to identify which processes generate the highest emissions or consume the most energy to make informed decisions about where to make changes. By comparing manufacturing and operations data against the manufacturing and operations digital twin, organizations can consistently monitor their actual energy consumption, measure the deviations from the normal, and benchmark it against their peers in the industry.

Operational emissions aren't the only area of concern, however. Supply chain emissions often have greater environmental implications, so manufacturers are looking to reduce their overall emissions by bringing their supply chains closer to their consumers. They are also looking to bring transparency in the total emissions across their supply chain. They would like to be more flexible about what they outsource, where they outsource, what they make, how much of it they make, and where they make it. These tasks require finding alternative suppliers, new greenfield projects, or the expansion of existing manufacturing and operations facilities through brownfield initiatives.

Digital tools can help here, too. When manufacturers can accurately calculate total emissions from alternate suppliers, new manufacturing and operations plants, or additions to existing ones, they can gain new insights into the total emissions across their supply chain. These insights help organizations craft a supply chain strategy.

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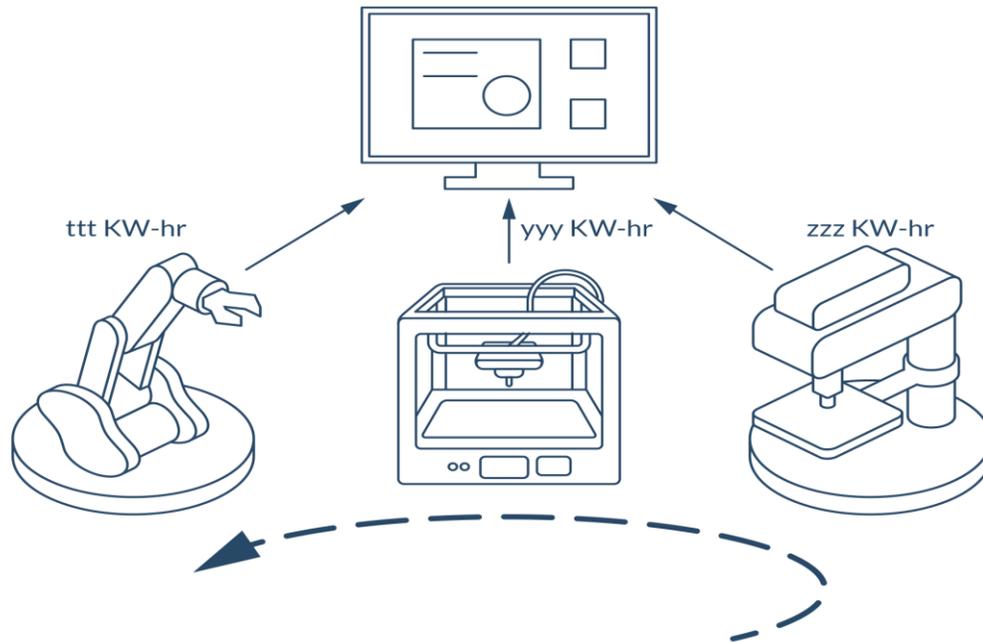


Figure 1 – Monitoring and then comparing energy consumption of all machines on the plant floor can help companies identify areas where they can be more efficient.

RESKILLING AND SAFETY

Another driver inspiring more manufacturers to adopt digital transformation initiatives is the need to reskill employees and facilitate increased health and safety awareness. Manufacturing and operations are witnessing increased digitization and automation. To stay ahead of the competition—or, at the very least, keep up—companies need to adopt new technologies. But this has implications for both the existing workforce and any new employees who are onboarded: They will need to be reskilled to use these tools.

Today, manufacturing and operations organizations would like to retrain existing workers so they are ready to leverage the technologies of the future. Workers need knowledge and training to effectively use tools like the manufacturing and operations digital twin and augmented reality/virtual reality (AR/VR). Once workers are familiar with these technologies, companies can more easily and effectively get them acquainted with their duties before they ever set foot on the factory floor. These tools, in turn, will also enable organizations to provide continuous training on other new and emerging technologies that are coming down the pipeline.

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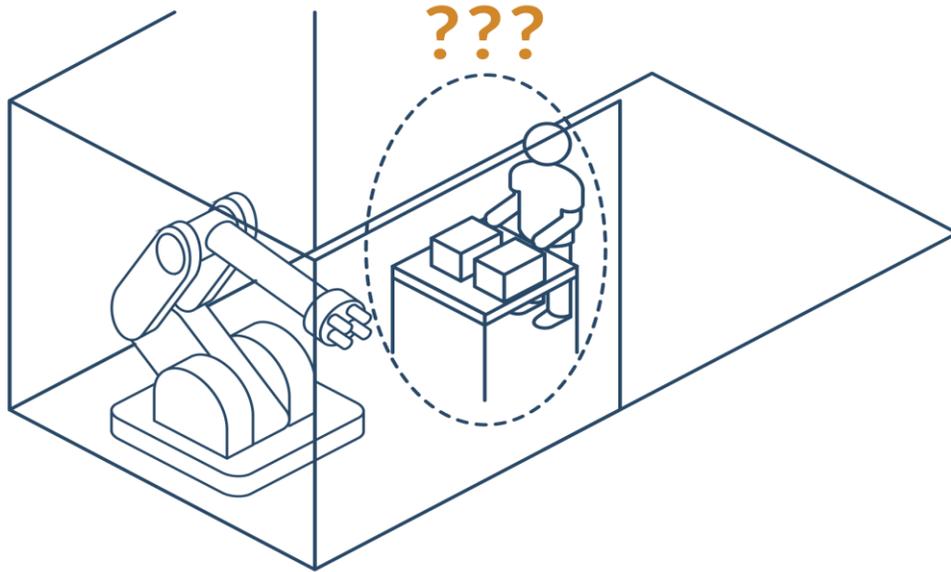


Figure 2 – Manufacturing and operations plants contain many robots and machines, so organizations need to find ways to ensure human safety in shared areas.

Digital tools can also play a pivotal role in ensuring safety in manufacturing and operations plants. The COVID-19 pandemic brought into full relief the importance of safety in day-to-day operations. Manufacturers now see that, if they want to continue operations during a crisis, they must be able to predict safety concerns and solve their safety issues. One area where this is of utmost importance is factory air quality. Digitally modeling manufacturing and operations plants and performing airflow simulation using computational fluid dynamics (CFD) can help companies understand airflow patterns inside the plant, predict air quality near workers, and identify other areas for improvement, like locating additional fans or exhaust ducts.

Manufacturers must also consider the human-machine interactions inside a factory when they look to improve safety awareness. Humans must work near robots and other machines to do their jobs, which is not without risk. Digital tools that identify weak safety zones and simulate potential mishaps can help executives design better factory layouts and safety protocols to promote worker safety.

FLEXIBILITY AND RESILIENCE

Manufacturing and operations organizations seek to mitigate risks and respond quickly to operational disruptions. The recent disruption was a big

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test for manufacturers all over the globe. More progressive organizations had the flexibility to rebound quickly and meet the growing need for new products despite the disruptions.

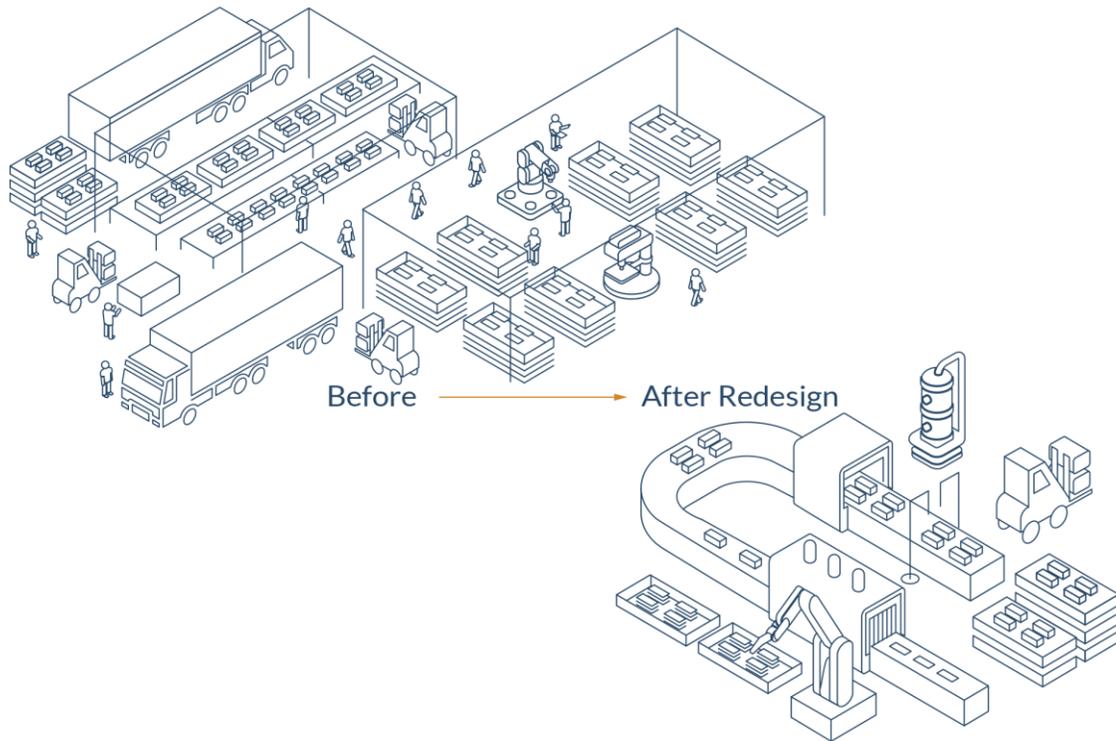


Figure 3 – Executives can redesign manufacturing and operations setups using digital tools to respond to new realities more quickly and effectively.

This widespread epidemic, however, is far from the only crisis that manufacturers have faced. Over the last decade, a host of different global crises have disrupted operations, including the effects of climate change, natural disasters, epidemics, wars, and supply chain issues. Such disruptions are likely to continue. Military conflicts, such as the current situation in Ukraine, cause ripple effects on supply chains all over the world. Prices of essential industrial commodities like oil and metals have risen dramatically. Furthermore, many companies are struggling to get the materials they need from their usual suppliers.

To protect themselves from such disruptions, more organizations are arming themselves with digital tools and technologies that will allow them to respond more quickly to issues. They can use those tools to repurpose existing manufacturing and operations assets, plan for additional automation, or make other key changes when they face problems like a shortage of skilled labor or a lack of needed raw materials.

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When manufacturing and operations organizations adopt these kinds of tools, they can determine what changes to make, how existing setups might be leveraged for new products, and more. The use of a manufacturing and operations digital twin can help manufacturing and operations executives answer these questions—and find ways to appropriately respond to new realities quickly and effectively.

FASTER TIME TO MARKET

One important mission of manufacturers is to develop and deliver new products to market. To gain market share quickly, manufacturers hope to get their products to market faster than their competitors, which requires careful and effective planning. Whenever an organization manufactures a new product, it needs to take time for proper manufacturing and operations planning. Such planning involves altering the setup of the existing manufacturing and operations line, which isn't feasible when that line is being used for production. When organizations can leverage a manufacturing and operations digital twin, however, they can perform manufacturing and operations planning and simulation on the digital model of that line. Executives can simulate the manufacturing and operations process on a computer, calculate critical parameters, and predict possible problems before they occur.

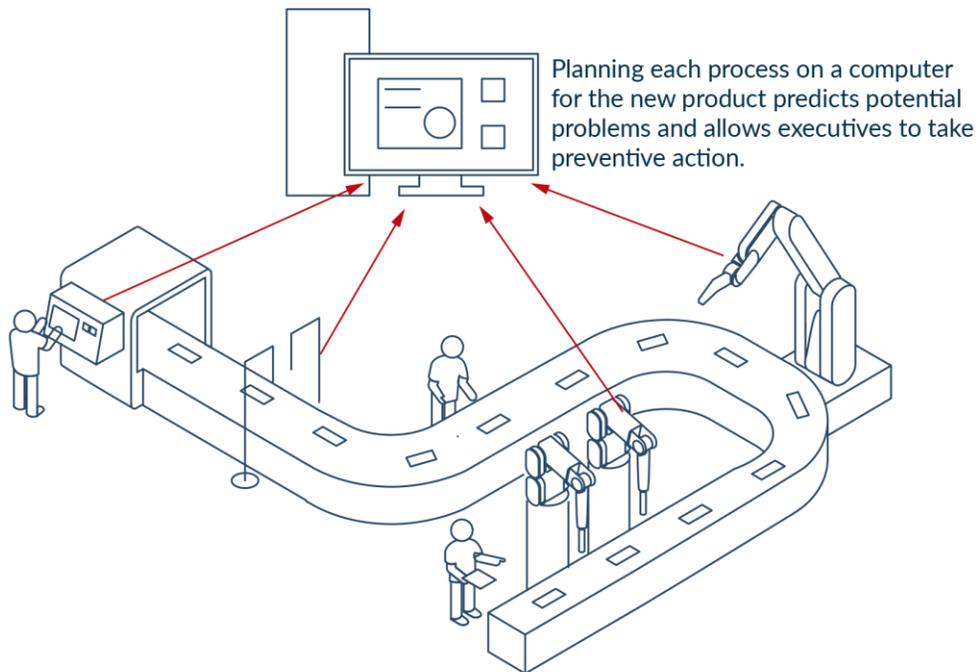


Figure 4 – Manufacturing and operations executives can use digital twins of the manufacturing and operations facility to plan production and discover any potential issues before they become too costly.

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Manufacturing and operations planning can be an enabler or a bottleneck when it comes to bringing products to market faster. Problems discovered late in the development, in the manufacturing and operations stage or beyond, can cause significant production delays. Such delays have a financial impact on the organization, including lost hours of labor, increased inventory, and even potential penalties to the manufacturer. Organizations that leverage a manufacturing and operations digital twin can minimize these issues, reducing costs and boosting profits.

TAKEAWAYS

Manufacturing and operations organizations are facing unprecedented pressures that are inspiring them to consider new digital transformation initiatives. Those drivers of change include:

- ***Sustainability and carbon footprint.*** Progressive organizations don't just care about reducing their environmental impact. They also understand sustainable practices and a reduced carbon footprint help make them more competitive in the marketplace. The use of digital transformation solutions can help them model and simulate operations and find ways to cut their carbon emissions.
- ***Reskilling and safety.*** Advances in new digital and automation technologies mean that manufacturing and operations workers need new training. Digital transformation initiatives can support this education and promote safety awareness as organizations look to reduce accidents across the factory floor.
- ***Flexibility and resilience.*** The recent global health epidemic showed that manufacturing and operations is not immune to business disruption. The use of digital transformation tools can help organizations become more flexible so they can better respond to business disruptors in the future, whatever they may be.
- ***Faster time to market.*** Today's manufacturers feel the need for speed. To successfully differentiate themselves from competitors, and bring new products to market faster, progressive organizations are using digital transformation projects to find ways to improve and speed up production.



ENABLING METHODOLOGIES

With so many drivers of change urging manufacturing and operations companies to implement digital transformation initiatives, many organizations are looking to adopt digital twins of their manufacturing and operations setup. But to successfully leverage a digital twin, organizations need to also consider key enablers. Progressive companies have found success with three key methodologies:

- building a baseline of the manufacturing and operations setup,
- optimizing the baseline setup by performing interactions on the computer, and
- executing the manufacturing and operations.

This section explores these three methodologies in detail and how a company can successfully leverage a production digital twin to significantly improve its manufacturing and operations processes.

MODELING AND SIMULATING: BUILDING A DIGITAL TWIN

The first step in this digital transformation journey is to understand the current state of manufacturing and operations and then bring it to life in a

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digital format. Most organizations already have a functioning manufacturing and operations setup in place. Most organizations already have a functioning manufacturing and operations setup in place, and they must model the digital twin of this current setup to build a baseline. Engineers model the existing manufacturing and operations setup on a computer using realistic 3D models.

Using the digital 3D model, engineers establish a one-to-one correspondence between the digital model and a new or existing plant. This becomes the digital twin of the manufacturing and operations facility. Once that digital twin is established, engineers can simulate the manufacturing and operations process on a computer to compile the baseline parameters for operation. They can then compare those numbers with the current process parameters to improve the model.

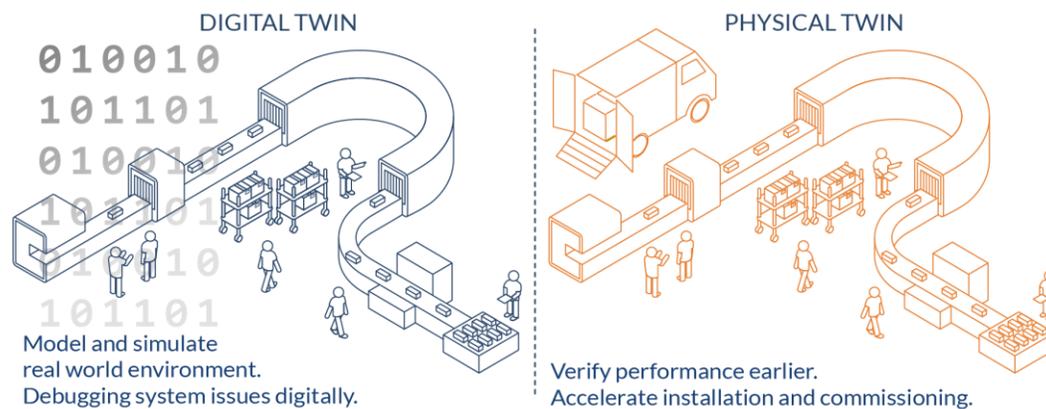


Figure 5 – The digital twin of the factory can be modeled and simulated on a computer to debug potential system issues digitally without disrupting production.

A manufacturing and operations digital twin also enables companies to perform virtual commissioning. Virtual commissioning allows production planners to develop and validate systems using simulation before any physical commissioning occurs. During validation, manufacturers can test that the production system fulfills all manufacturing and operations requirements. In addition, it can help resolve any issues associated with human-machine interfaces (HMIs) and programmable logic controllers (PLCs). The latter is not unlike identifying and fixing bugs in software, which is why this activity is commonly referred to as “debugging” the production system. By using the digital twin for virtual commissioning, executives can reduce the risks and extra costs involved when they go straight to physical commissioning.

A manufacturing and operations digital twin can also help support collaboration both within and outside of the enterprise. Delivering a world-

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class product requires a collaborative process across many functional departments, including design, production planning, and operations. To create optimal products, many stakeholders need to participate in the design and development process. Any manufacturing and operations digital twin solution must have the capability to bring all stakeholders together on one digital platform to support ongoing communication and collaboration.

ITERATING AND OPTIMIZING: EXPLORING DIGITAL TWIN WHAT-IFS

Building the baseline is only the first step in finding success. After companies create a baseline digital twin model of their manufacturing and operations setup, they can take that model further.

As engineers think about how to optimize production, they often consider what might happen if they change the current baseline's structure. They may want to explore a wide range of "what if" scenarios. Such iterations and explorations aren't feasible on the shop floor, but they are possible with a manufacturing and operations digital twin. The manufacturing and operations digital twin allows engineers to explore these "what-if" scenarios through simulation, improving and building on the current baseline.

Using the digital twin, engineers can iterate on different arrangements of the digital model, even adding new machines and lines to solve specific problems or to optimize the existing setup to meet particular objectives. Manufacturing and operations engineers could use the digital twin to maximize throughput from a specific station, thus affecting the overall manufacturing and operations output.

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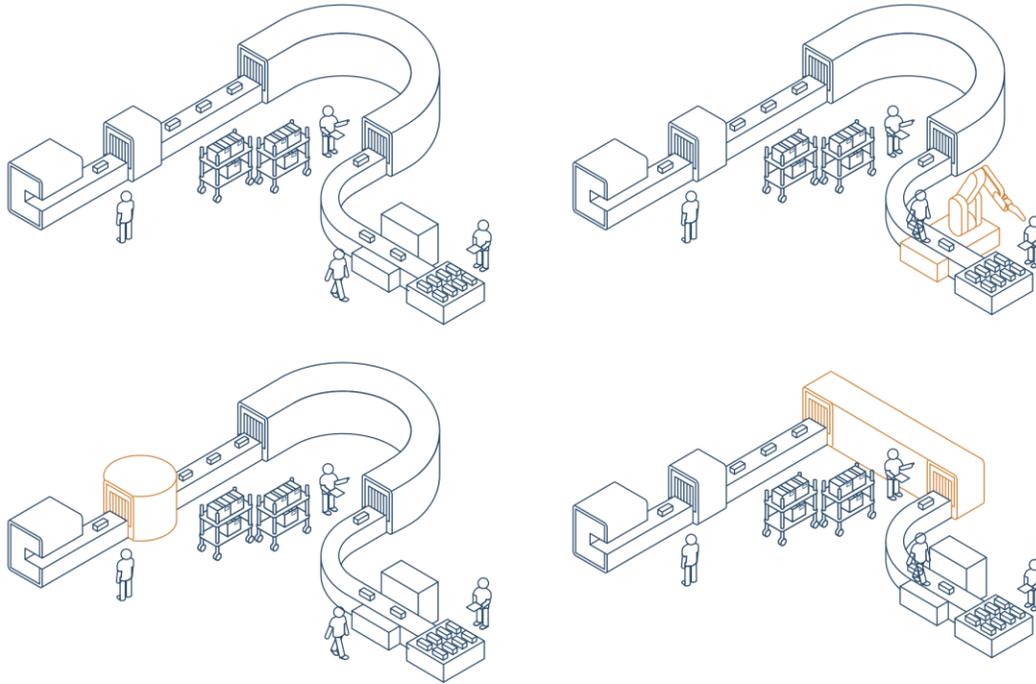


Figure 6 – By modeling and simulating multiple “what-if” scenarios on a computer, engineers can eventually develop and adopt an optimized configuration.

Performing optimization of this type requires sophisticated models of each machine and entity in the manufacturing and operations process. A manufacturing and operations digital twin provides these models. Any robust solution supporting the creation of a manufacturing and operations digital twin will offer a standard library of machines and robots from various providers—and will also allow engineers to input and maintain customizable models where needed.

The benefits of optimizing the manufacturing and operations setup using digital models cannot be understated. To start, engineers can improve existing layouts by validating any changes on the computer, saving the company time and money without disrupting current production. Companies can further benefit when they use these models to consider whether or not to add to the existing setup with new assets. By running optimization simulations, companies can find the asset that best suits their needs and make appropriate plans for any changes required by the new additions. The digital twin allows them to plan ahead, providing additional workforce, if needed, as well as the proper training for that workforce well before production begins.

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EXECUTING AND OPERATING: MERGING IT AND OT

Adopting a manufacturing and operations digital twin can help companies build and further improve upon a baseline model through optimization simulations. But the benefits of a manufacturing and operations digital twin don't stop there. They extend beyond the planning phase into the execution or operation phase.

A manufacturing and operations digital twin does not have to be static and disconnected from the factory floor. Many progressive organizations will connect the digital twin with actual manufacturing and operations data streamed from their operations. The idea is to stay apprised of the realities of current manufacturing and operations data using real-world sensors in the plant. This data can be integrated with data already in the manufacturing and operations digital twin model, merging IT (Information Technology) and OT (Operational Technology) in a way that offers a strong business benefit.

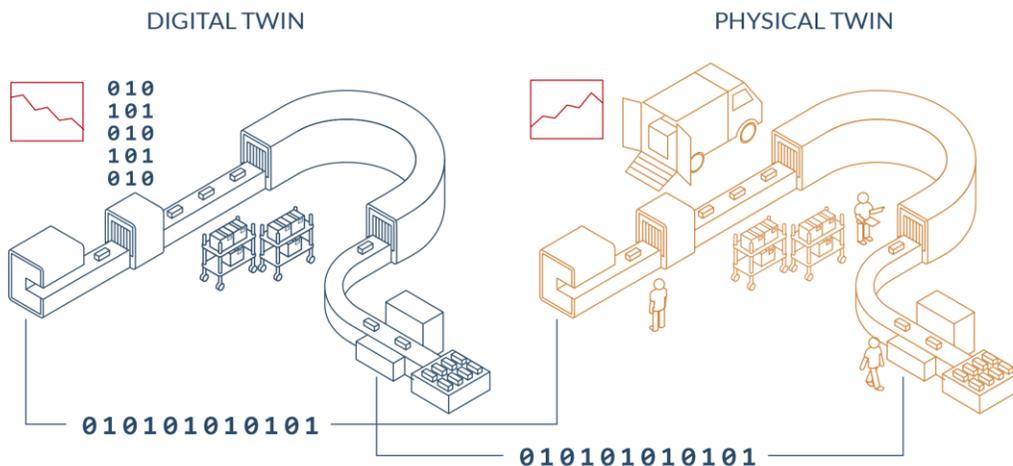


Figure 7 – Factory data can be streamed to the digital twin in real time, feeding into analytics engines to help engineers monitor performance and identify anomalies.

This merged information can help executives make more informed business decisions. A plant manager can use the data to spot anomalies in assets currently working on the floor and use the manufacturing and operations digital twin to understand what the real problem is. The digital twin can also troubleshoot and identify optimal solutions for any issues with minimal disruption. Furthermore, engineers can use artificial intelligence (AI) and machine learning (ML) techniques to schedule predictive maintenance and

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address issues before they occur. By staying connected to the data, manufacturing and operations leaders can keep their assets in good working order, reduce down time for those assets, and potentially extend the life of those assets.

Finally, engineers need to collaborate with key stakeholders when executing various operations in a manufacturing and operations plant. It is common for engineers to collaborate with members of the procurement team to ensure critical raw materials required for production are available and will be sourced on time. They may need to communicate delivery-related information to customers. A comprehensive manufacturing and operations digital twin solution enables these crucial collaborations. It makes it easy for stakeholders to manage and retrieve all communications in one central location where those communications are tied to manufacturing and operations-related data to provide the appropriate context.

TAKEAWAYS

A manufacturing and operations digital twin offers many benefits. But successful organizations adopt strong enabling methodologies to ensure they can get the most value out of their digital transformation investments. Those enablers include:

- ***Modeling and simulating to build the digital twin.*** The creation of a 3D model with a one-to-one correspondence with the physical plant supports virtual commissioning to help engineers save on costs and time as they develop their manufacturing and operations plans.
- ***Iterating and optimizing to explore “what-if” scenarios.*** Once a baseline digital twin is established, it is important that organizations refine the model so it can provide digital support for improvements of the factory floor.
- ***Executing and operating through merging IT and OT.*** Organizations that can merge data from information technology systems and operations will be able to further optimize their digital twin. In doing so, they can create a digital transformation solution that improves operations and also provides data so company executives can make better, more informed decisions.



SUCCESSFUL DEPLOYMENT

Once an organization has created and optimized the manufacturing and operations digital twin in support of its digital transformation effort, the next step is to deploy it. Successful deployment, however, takes careful planning. Long before any software is installed, progressive organizations will take the time to set up the right foundation for it. These include:

- Understanding the organization's needs and aligning its manufacturing and operations digital transformation vision accordingly
- Planning and executing a successful pilot and learning from this experience
- Expanding the pilot to other areas of manufacturing and operations, and supporting the teams to ensure successful deployment

This final section discusses these foundational practices for successful deployment of a manufacturing and operations digital twin.

UNDERSTANDING THE NEED AND ALIGNING

The most critical steps in any manufacturing and operations digital transformation initiative occur long before the installation of software. Before implementing any new system, manufacturing and operations executives

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should gather stakeholders from across the organization to drive alignment behind the effort. Together, they can identify the driving needs of the organization and prioritize them according to the value that each brings to the enterprise.

Driving alignment begins with the development of a long-term vision for the company. Each organization has its own journey that can only be described and defined by the company itself. Leaders can work together to paint a long-term picture of how manufacturing and operations will run after deploying a digital twin. But, too often, organizations approach the implementation of a digital twin without sufficiently preparing their user base for the changes to come.

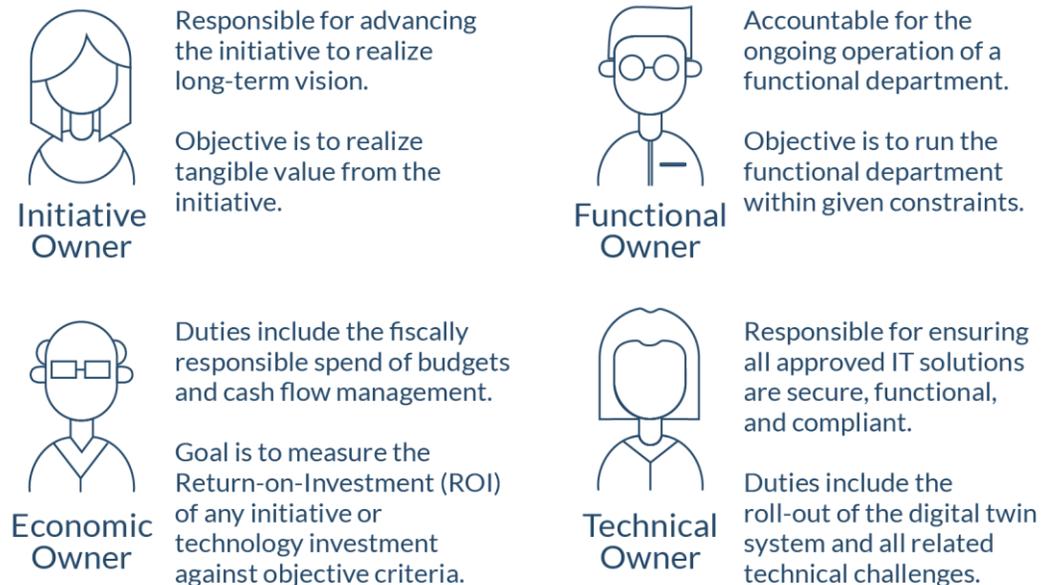


Figure 8 – Different owners for digital transformation initiatives may have different interests and goals.

Successful change management requires that users understand the big picture benefits of any change. The onus is on leaders to deliver the big picture, sharing their vision and clearly articulating their plan to move forward. This may involve a company-wide meeting where executives directly state something akin to, “We are embracing a manufacturing and operations digital twin to provide our customers with high-quality products, while finding ways to reduce costs, minimize delays, and be more competitive in the market.” But management cannot just rely on a single meeting to help support these changes. They must reinforce the mandate through continuous

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communications to the enterprise, both live and electronically, to help keep everyone in the organization on the same page.

Finally, executives driving these digital transformation changes must prepare to make tough decisions throughout the change management process. One way or another, conflicts will arise at some stage of a digital transformation initiative, including those that involve implementing a manufacturing and operations digital twin. Leaders who are prepared to mediate the outcome of proposed process changes, figuring out next steps when a project runs late or settling on the appropriate managing governance of the project, will be much better positioned for success. In each of these scenarios, leaders must provide a forum for all constituencies to be heard and negotiate a shared path forward. When owners have established a clear process for resolving conflicts among themselves, they prepare executive leadership to make their own tough choices as the initiative moves from plan to implementation.

To best prepare to implement a manufacturing and operations digital twin, it is also essential to openly discuss hypothetical scenarios where conflict is likely to arise and define steps to resolve any issues. One of the best ways to facilitate this discussion is through cross-functional committees. Stakeholders who represent different owners can provide input on the process using the parameters of the forum to support positive discourse and forward progress. Once stakeholders agree upon routes of resolution for different scenarios, the cross-functional committees can then update everyone on them, so there is transparency for concerns and redress.

ESTABLISHING THE PROOF OF VALUE

The first proof of value of any digital transformation effort is critical. It represents the initial step toward achieving executives' long-term vision for the program. It sets the tone for pursuing and then achieving tangible value for the associated stakeholders, setting the stage for later success or failure. Progressive companies that have gotten the most value out of their manufacturing and operations digital twins have adhered to the following guidelines to ensure their success.

Target something valuable. When the pilot effort can solve a real, tangible problem acknowledged by the functional owner, others will see how the effort fits in with the company's mission—and how it can be leveraged for success.

Tightly scope the initial pilot project. This is not the time to include everything that can be done. But instead, identify the minimum deployment that will solve the defined problem. It can be tempting for organizations to try and expand the scope of their efforts, but it is important to maintain discipline. By keeping

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things as tight as possible, leaders can help avoid any potential issues that may derail their efforts as they work to show value to other stakeholders.

Focus on specific objectives. Organizations can see success when they target a real, tangible problem and then use that as a guide moving forward. While there will certainly be surprises along the way, following that initial guide to completion will help keep the deployment team on track, avoiding potential distractions or derailments.

Measure success with defined metrics. After defining the problem and the specific objectives required to solve that problem, successful organizations can support those objectives with defined metrics to show stakeholders how the pilot is working.

Work closely with the solution provider. Every company is unique—and, fortunately, solutions providers have vast experience with a range of issues. By working closely with trusted vendor partners during the piloting stage, organizations are more likely to avoid common pitfalls, and quickly mediate any other problems they may encounter.

Enable users. Finally, one of the most critical steps organizations can take to ensure the success of a pilot is to get users in on the action. Without their execution of process changes—and understanding just what such changes will entail—organizations will have little chance of realizing the promised benefits of their implementation. The best ways to enable users include providing:

- well-defined and customizable user training,
- on-demand materials to help users improve their skills further,
- designated experts within the organization to answer questions or supplement training,
- technical support, and
- continued internal communications from the initiative owner.

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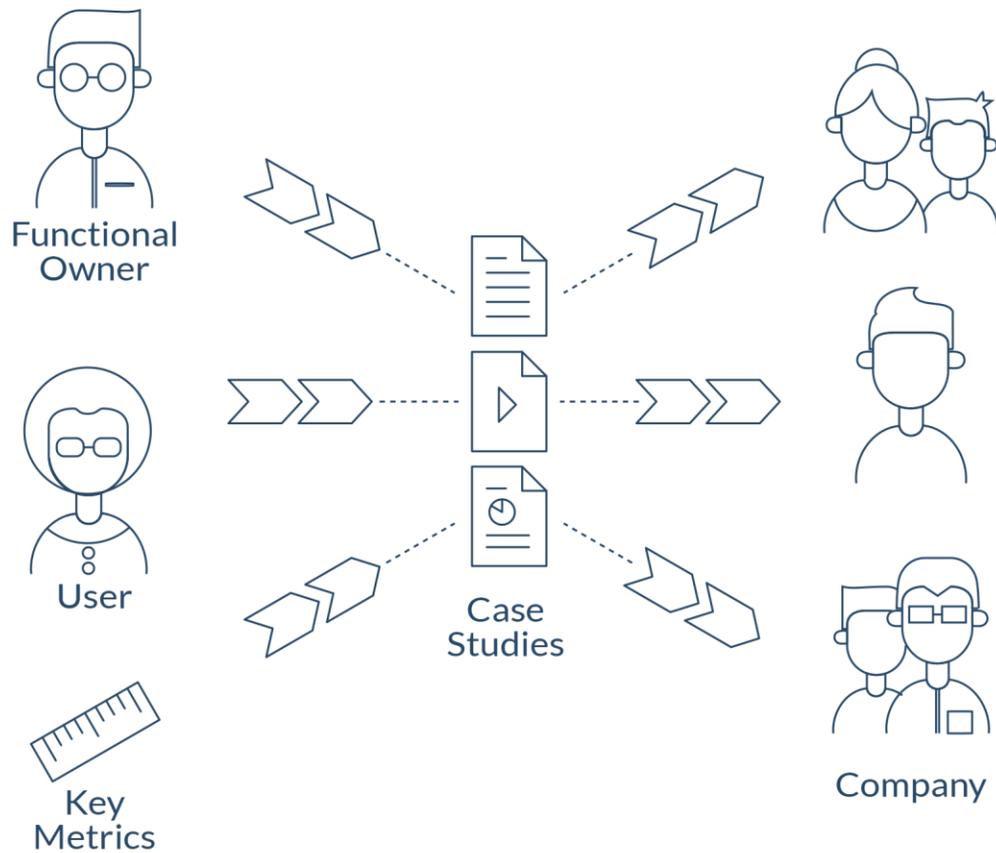


Figure 9 – Documenting pilot success and sharing case studies with the company fosters alignment across an organization.

Beyond these guidelines, the best way to expand alignment for any digital transformation initiative, including a manufacturing and operations digital twin, is to showcase small, progressive, and continuous successes. The small wins matter—and they matter a great deal. When companies can share those wins by publishing each story as a case study with a combination of interviews, quotes, commentary, photos, diagrams, videos, and other supporting media, they can champion their efforts and help ensure the entire enterprise is on board with continued changes. Remember, different stakeholders consume information differently. When companies provide comprehensive case studies, with a variety of media, they are more likely to reach a wider audience across the organization.

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EXPANDING AND SUPPORTING

Once an initial pilot of the digital transformation project is complete, companies can take the next steps to advance their long-term vision for success through small, achievable projects. The process and technology changes that come with deploying a digital transformation initiative often can result in cultural pushback. Some employees may see the changes that are being made as disruptive to their day-to-day work—and they may not be wrong. It is vital not to push changes, but rather adopt a pull deployment style that inspires constituents to seek out the change. Once again, companies can move to that pull mindset when they follow the pattern used for the pilot implementation: plan, enable users, and then capture and share success stories.

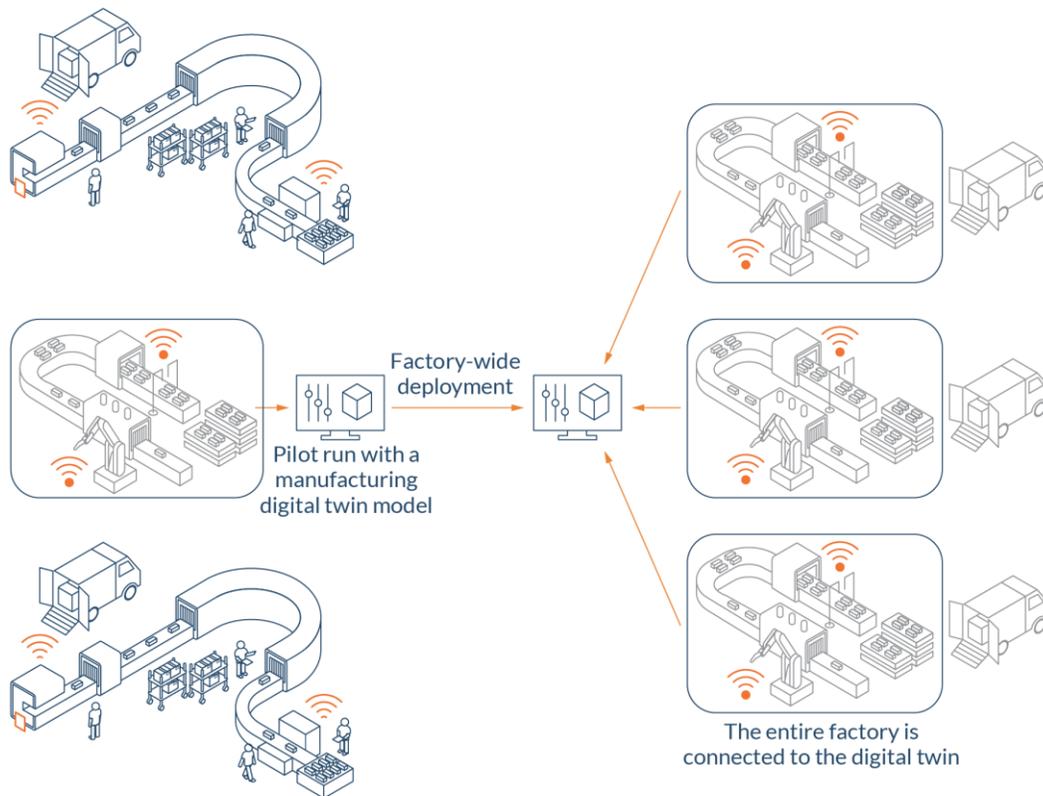


Figure 10 – Manufacturing and operations executives learn from a pilot deployment and then leverage those lessons to help them roll out a factory-wide implementation more smoothly.

Manufacturing and operations is a hectic line of work. Stakeholders should not be surprised if the digital transformation initiative's long-term vision and progress become jumbled in everyone's minds—including both engineers and C-suite executives—over time. Companies can keep everyone on the same

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page by providing visibility into the initiative's progress and sharing reminders of past successes and recent wins in case studies.

Broadcasting progress towards an organization's long-term vision is key to driving alignment. It is equally important that companies maintain alignment with sponsor executives as they go. Providing updates on progress on a predefined schedule can help. Those updates should include:

- headway toward the realization of the long-term vision,
- a roadmap of the initiative's expansion into specific application areas,
- a dashboard summarizing the various deployments,
- organizational metrics, both good and bad, and
- discussions surrounding tough decisions to highlight how the organization is finding the right balance between initiative advancement and productivity of functional departments during implementation.

Deploying a digital transformation initiative requires efforts to help functional owners and users navigate process changes, skill upgrades, and the use of new systems. These are all short-term efforts, but there is also a long-term need for ongoing support. Successful organizations provide ongoing support for users, including progressive training programs and technical support. Doing so helps to bolster acceptance of these projects and minimizes user regression to depreciated processes.

TAKEAWAYS

The successful deployment of any digital transformation initiative, including a manufacturing and operations digital twin, requires careful planning before any systems are deployed. Progressive organizations understand the need for alignment from the very beginning of their digital twin journey. Thus, organizations that do the following will find they can achieve the value they seek from their manufacturing and operations digital twin implementation:

- *Understanding the need and aligning.* Organizations that engage stakeholders from across the company will be able to better identify opportunities for improvement, as well as key metrics to measure progress.
- *Piloting and learning.* Organizations that start small with a niche pilot project will be able to gather significant lessons learned to help them with expanded rollouts later. Furthermore, by communicating those lessons learned as they go, manufacturers can continue to build alignment and transparency.

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- *Expanding and supporting.* Once a pilot project is successfully completed, successful organizations can build upon what they've learned to continue with their deployment. Communications with users should continue, but organizations should also take a long-term view of support, providing training and technical support throughout the entire digital transformation journey.



SUMMARY AND RECOMMENDATIONS

Manufacturers are looking for ways to optimize their operations and build resilience in the face of common business disruptors, as well as to make themselves more competitive in the marketplace. As a result, many companies are looking to adopt digital transformation initiatives like the manufacturing and operations digital twin to help them test and validate new manufacturing and operations processes. In this way, they can avoid costly physical implementations that may not benefit the enterprise.

Manufacturers that have already embarked on the implementation of a manufacturing and operations digital twin have learned lessons that can benefit others. Their experiences can make it easier for other organizations to successfully implement their own digital transformation initiatives. This report highlights the following:

- *Drivers of change.* Organizations are looking for ways to address today's most pressing manufacturing and operations challenges, including reducing their carbon footprint, improving safety, supporting more flexibility and resilience in the face of business disruptions, and improving production to deliver products to market faster.

REALIZING VALUE FROM DIGITAL TWIN INVESTMENTS IN MANUFACTURING AND OPERATIONS

- *Enabling methodologies.* A successful implementation requires more than just some new software investments. Organizations that take the time to build a baseline manufacturing and operations digital twin through modeling and simulation, and then optimize it by using both IT and OT data, will find they are in a better position to directly address specific use cases using the digital model.
- *Successful deployment.* Even once a model has been created, one of the most taxing efforts in any digital transformation initiative is strong change management. By understanding what problems the digital twin can address, building alignment among stakeholders, starting small with a specific pilot project, and then expanding efforts with ongoing technical support and transparency, manufacturing and operations organizations will be able to realize tangible value from their manufacturing and operations digital twin.

By embracing the lessons learned by the most progressive manufacturers, other organizations can build a strong foundation for success. As they embark on their digital transformation journey, these organizations should adopt the following practices:

- Understand key drivers that are pushing today's manufacturing and operations organizations toward a manufacturing and operations digital twin—and further identify the challenges that such a solution is meant to address.
- Carefully examine existing manufacturing and operations processes to see where improvements can be made to address challenges and increase value.
- Conduct diligent research on different digital solutions for manufacturing and operations to ensure the correct solution is in place.
- Invest in training for the engineering teams once the solution is identified, as waiting any longer may mean workers lack the relevant expertise to leverage these new solutions to realize the best value for the business.
- Consider the following benefits when planning the rollout of any digital manufacturing and operations planning and operation initiative: increased sustainability, increased safety, and the ability to support better, earlier decisions.
- Implement appropriate monitoring and assessment strategies to quantitatively demonstrate progress, retain transparency, and realize tangible benefits from investments.

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The most progressive manufacturing and operations organizations are realizing tangible value from digital transformation investments, including the manufacturing and operations digital twin. When companies can rely on a real-time digital model of the physical factory floor, they are in a much better position to weather common business disruptions, as well as save time and resources as they bring their products to market.



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