

THE VIRTUAL TWIN EXPERIENCE

Optimizing operations by connecting the real and virtual worlds

THE INDUSTRY THAT
DRIVES INNOVATION

KEY CHALLENGES IN
MANUFACTURING

KEY TRENDS IN
MANUFACTURING AND
OPERATIONS

SEVEN ADVANTAGES
OF THE VIRTUAL
TWIN EXPERIENCE IN
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INNOVATION
TIME HORIZONS

- Facility Planning
- Process Planning
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It has been about a decade since the world entered the Industry Renaissance, where a wide array of industries began moving towards digital transformation; transitioning from manual processes to automated systems and replacing older digital technology with cutting edge technology.

With the explosion in demand for a wider variety of customized products catering to personalized customer needs, the role of manufacturers in catering to shifting market demands is more crucial than ever. However, it is a major challenge for manufacturers to maintain the throughput required to meet these demands while keeping operations within budget. Manufacturers can overcome this gap by leveraging a virtual digital solution that enables them to visualize the perfect plans for new products, facilities and production processes in order to run optimized manufacturing operations.

In this paper, you will learn about:



Challenges and key trends in manufacturing



The advantages of using a Virtual Twin to plan and manage operations



What the Virtual Twin Experience can achieve for manufacturers



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KEY CHALLENGES IN MANUFACTURING

A wide range of industries rely heavily on manufacturers from transportation to high-tech and consumer goods. The importance of their role places them at the heart of progress and innovation in society. However, this also creates many challenges as a result of new disruptions:



EXPLOSION IN PRODUCT VARIANTS

Consumers constantly want new types of unique and customized products, and this poses a huge challenge for manufacturers to produce so many product variants efficiently with constrained assembly lines and resources.



SUPPLY AND DEMAND VOLATILITY

Disruption and changes in supply and demand will always be a challenge for manufacturers, requiring visibility and agility across the supply chain.



INCREASING REGULATORY PRESSURE

As product experiences become more complex and integrated to our lives, manufacturers face greater regulatory and certification pressure to ensure products provide safety and security.



ACCELERATION IN INNOVATION

Manufacturers need to adapt to the accelerating pace of innovation for products. New technology being developed and added requires manufacturers to develop more efficient operations in order to keep up with innovation.



SUSTAINABILITY IS A NECESSITY

Manufacturers face greater expectations to create products through economically sound and socially responsible processes that strive to eliminate environmental impact while conserving energy and natural resources.

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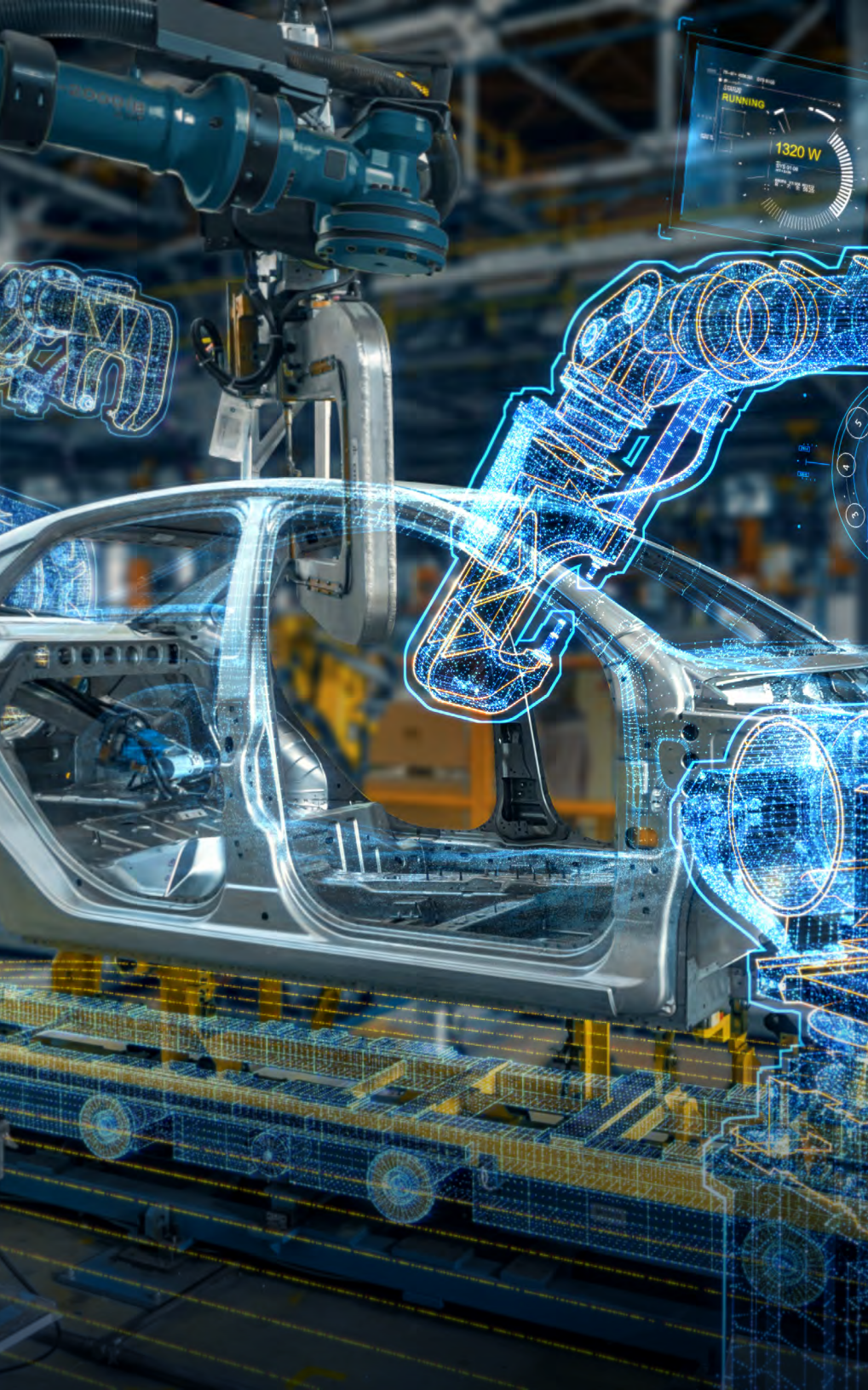
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The “next normal” that manufacturers face due to modern disruptions has also amplified certain challenges that raise the urgency for companies to work towards the following to ensure the longevity of their business:

- ✔ **Prioritizing re-skilling and safety**
to avoid dependency on key skills
- ✔ **More workforce automation**
to help employees multitask and cover skills gaps
- ✔ **Supply chain resiliency**
gives companies options to optimize in economically difficult situations
- ✔ **Maintaining business continuity**
by ensuring that all operations are efficient
- ✔ **Flexible and agile manufacturing**
is necessary to help companies adapt to new changes

Discover the future of sustainable manufacturing and how you can make it happen by:

- Connecting the virtual and real world to compare different scenarios and improve workforce safety
- Increasing your energy efficiency through digitalization
- Having real-time visibility over business and sustainability KPIs for informed decision-making
- Reducing waste in resources and productivity via lean manufacturing
- Making your products sustainable, working towards a circular economy and reducing CO2 emissions

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KEY TRENDS IN MANUFACTURING AND OPERATIONS

There are three key elements that manufacturers will want to pay attention to as these will drive future trends:



HUMAN

- The products we use today are designed and created by humans, for humans. This makes all our products very personal in the way they integrate with or help us manage human lives.
- Manufacturers need to put human experiences at the center of everything they design and produce—in every industry from life sciences to home and lifestyle.
- In embracing the Workforce of the Future, manufacturers need to focus on the way they recruit, engage and retain quality talent. Worker safety is of paramount importance and should always be a priority.



CONNECTIVITY

- The world needs high connectivity to function—smart cities and facilities where innovative systems can communicate with each other.
- The emergence of 5G networks will enable new possibilities for greater manufacturing output through the Industrial Internet of Things (IIoT).



SUSTAINABILITY

- Manufacturers have a corporate and social responsibility to be sustainable, both in operations and designing sustainable products.
- Explosion in product innovation increases the rate of obsolescence; companies must design products that last longer and use less power and resources.
- Companies are moving towards a circular economy—recycling waste to reduce environmental impact.

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SEVEN ADVANTAGES OF THE VIRTUAL TWIN EXPERIENCE IN MANUFACTURING

1 UNLIMITED SIMULATION
Manufacturers lack the time and resources to experiment and find optimal facility layouts and processes are often restricted to using older, established methods with a limited ability to improve them. The Virtual Twin Experience allows such experimentation to take place virtually and determine the best configuration before spending precious time and resources changing real-world operations.

2 CONTINUOUS IMPROVEMENT
The Virtual Twin Experience enables a closed loop connection between the virtual and real world, allowing simulated plans to be immediately and confidently executed. At the same time, real-time updates are captured from manufacturing to inform the Virtual Twin Experience, allowing it to continuously refine and optimize processes for a longer-term strategy.

3 IMPROVED HUMAN FACTORS
Workplace safety is important, but some unsafe working conditions may not be immediately apparent until an incident takes place. With real world data input, the Virtual Twin Experience can simulate worker operations in a facility and address safety concerns, such as identifying assembly tasks that could create repetitive strain injuries or creating social distancing measures.

4 ADDED AGILITY
Manufacturers struggle with suppressed margins due to competitive pressures while working with short production runs, making downtime costly when configuring an assembly line. The Virtual Twin Experience helps manufacturers be more flexible by simulating changeovers ahead of time and identifying the quickest and most cost-efficient way to do so, minimizing downtime.



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5

GLOBAL COLLABORATION

There are often digital “divides” between engineering and manufacturing departments that result in lost time and quality. The cloud-based Virtual Twin Experience enables stakeholders to share detailed information and animated 3D models that allow collaboration and input from all departments for optimal operations. Simulations in the Virtual Twin Experience even calculate how external factors affect the production process, improving its accuracy in optimizing configurations.

6

IIoT INTEGRATION

Most modern production equipment is sensor-driven and generates large quantities of real-time data—much of which is used for quality control and production monitoring. The level of integration that is now possible with the Virtual Twin Experience makes modern factory operations fully transparent to engineers and managers, allowing greater optimization.

7

KNOWLEDGE RETENTION

Losing key personnel with extensive knowledge of a manufacturer’s processes or translating code from obsolete legacy equipment for newer systems have traditionally hindered older manufacturing operations. These problems no longer trouble manufacturers who rely on the cloud-based Virtual Twin Experience, which integrates all information on the cloud and ensures data continuity.

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THE VIRTUAL TWIN EXPERIENCE

The **3DEXPERIENCE** platform is what our applications and solutions run on—it is the foundation for supporting model-based design, planning and execution. This cloud-based platform provides what we call the **Virtual Twin Experience**.

In the Virtual Twin Experience, the **virtual** world enables users to see what they want to accomplish through modeling, simulation and visualization, which can then be implemented and executed in the **real** world. At the same time, experience and data collected in the real world is used to update the virtual twin model and maintain it as a perfect twin that can be used to improve all aspects of real-world operations.

This **convergence of the virtual and real worlds** and the continuous cycle of information between the two achieves a closed-loop capability that enables optimization in virtually any scenario.



Achieve Sustainable Innovation and Excellence



Support the Creation of Value Networks



Empower the Workforce of the Future



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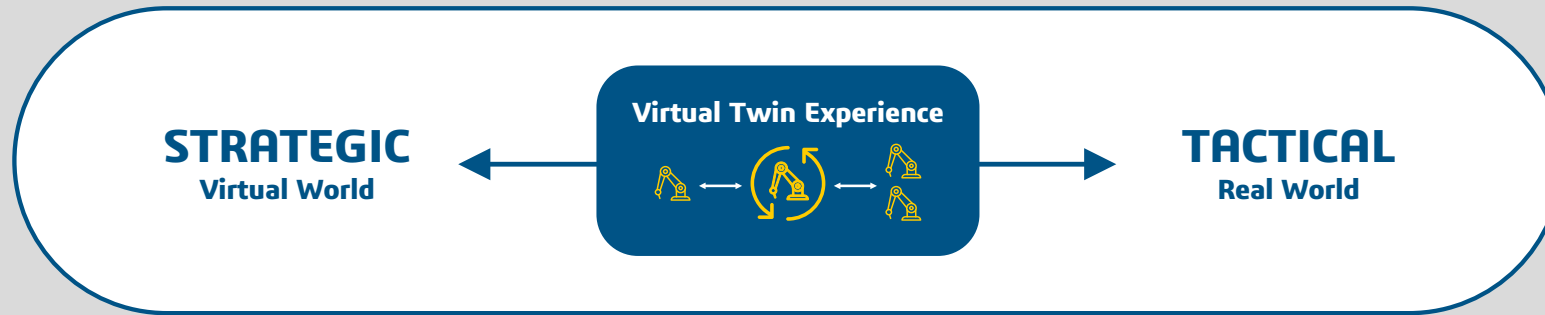
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What the Virtual Twin Experience enables for manufacturers:	How this is achieved:	Where the solution applies:
<ul style="list-style-type: none"> • To assess new products and evaluate potential changes in production as well as optimize production processes • To re-assess manufacturing strategies and capacity to mitigate shortcomings • To synchronize planning and execution to drive continuous improvement 	<ul style="list-style-type: none"> • By creating a virtual model to control, operate and improve real-world systems • By ensuring layout efficiency for operator safety • Through simulation as a lever for continuous improvement • By using facility flow simulation to increase flexibility and productivity • By optimizing layouts, work centers and process plans 	<ul style="list-style-type: none"> • Value networks, which includes suppliers, contract manufacturers, original equipment manufacturers (OEMs), line builders, machine builders, robotic vendors and system integrators • Facilities, warehouses and construction projects



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INNOVATION TIME HORIZONS

The **3DEXPERIENCE** platform features solutions that help manufacturers at every stage of a product's life cycle from the initial planning phase all the way down to manufacturing execution and delivery. The platform keeps manufacturers informed in their strategic decision-making—which involves planning in the virtual world—as well in their tactical decision-making when it comes to execution in the real world.



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FACILITY PLANNING

How to optimize physical space and assembly lines to manufacture new products?



Capabilities of the Virtual Twin Experience

- Create 3D virtual models (BIM & CAD) from any available 2D documentation or drawing
- Conduct mobile or fixed point scans of facilities to convert into a 3D point cloud
- Position and manipulate resource positions in 3D
- Validate and define facility floor with resources



Goals & benefits

- Validate use of workstations and tools in context
- Minimizes potential for design-induced risks to health, personal or environmental performance
- Avoid costly layout redesigns by enabling users to collaborate and share 3D layouts
- Efficient collaboration with suppliers and other partners in the value chain

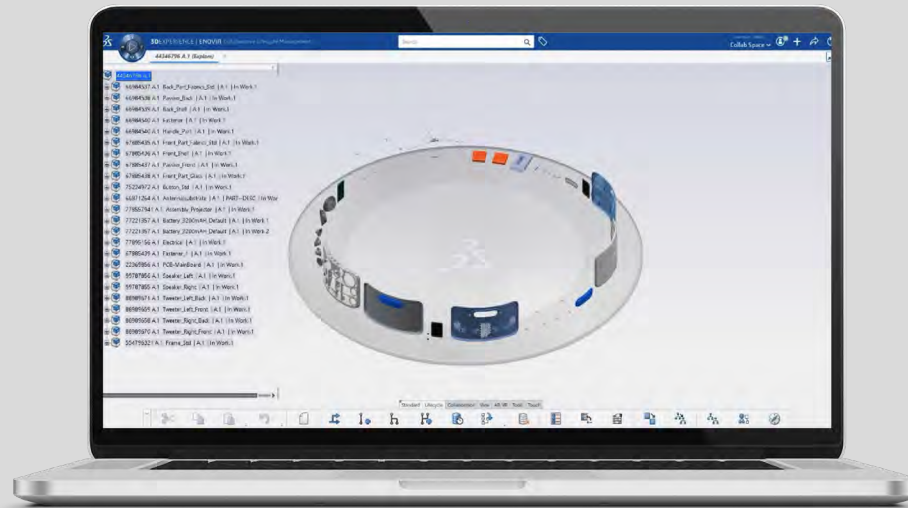
PROCESS PLANNING

How to optimize production process to maximize efficiency, cost, quality & safety?

As production planning shifts from engineering design to manufacturing execution, manufacturing companies face a challenge in translating designs into real world plans as both sides traditionally use different sets of tools that do not connect with each other. The lack of information flow and collaboration across the digital divide has real consequences for production:



The solution lies in asking if we can manufacture what we have designed—to do it efficiently and in a way that eliminates costly and time-consuming manual prototypes. The first step in achieving this is by using the engineering bill of materials (EBOM) to build up a manufacturing bill of materials (MBOM) through the **3DEXPERIENCE** platform.



Engineering bill of materials (EBOM) to build up a manufacturing bill of materials (MBOM)

Once this is done, the next steps involve looking at the ‘how’ and ‘where’ to manufacture the product. The **3DEXPERIENCE** platform enables manufacturers to **virtually simulate their process** plan in order to identify potential issues ahead of execution, which avoids many of the risks associated with real-world testing and also reduces product launch times.

Manufacturers can then create a complete **virtual build** that incorporates the MBOM and process plan and identifies the resources needed, how to improve resource utilization and potential quality issues in order to reduce work and scrap. Doing this virtually helps manufacturers save time and money that is otherwise spent on manual prototypes—shortening the time needed to bring products to market while raising quality and validating the process steps across the time horizon.

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As an added element, modern disruptions have amplified the importance of **planning for worker safety** on the facility floor. The Virtual Twin Experience can also account for this—not just in creating ergonomic work conditions, but also in simulating social distancing in facilities, calculating the new productivity rate and optimizing within these constraints.

Now that the Virtual Twin Experience has both the model and process set up, manufacturers have a clearer picture of how their product will be manufactured in their facility. The simulation can then be used as a lever for continuous improvement in manufacturing flexibility and agility.

Capabilities:

- Design factory layouts and analyze multiple production scenarios
- Optimize process performance with alternate product routings
- Natively integrate robot, numerical control (NC) machine programs and human tasks into model

Goals & benefits:

- Workforce safety
- Agile manufacturing
- Optimize production performance



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MANUFACTURING PLANNING

How to optimize production while managing constraints?

This stage of the time horizon is where manufacturers apply forecast data on demand and supply to the model to simulate how the model performs and how operations can be optimized while managing constraints in manufacturing, assembly and distribution.

The time horizon for this stage may still be quite varied. At the highest level, Sales & Operations Planning (S&OP) might be performed monthly or quarterly and look up to several quarters out. This allows organizations to help analyze global supply chain constraints and possible “what-if” plans to deal with fluctuating supply and demand scenarios.

The time horizon could also be more tactical—for example, generating a more detailed Master Production Schedule that considers more granular constraints of resources, materials and bottlenecks in production.

There are numerous opportunities in this area and the various optimization engines that leverage Machine Learning and Artificial Intelligence are significant drivers of agility and planning in the face of both certain and uncertain future elements. With so many possible scenarios to consider, it is sometimes difficult to develop any single feasible plan, let alone an optimal plan.

When developing strategic plans, it is important to represent the business KPIs that are critical to success in multiple scenarios so that manufacturers will have a sustainable plan in place yet are able to respond quickly to sudden changes in factors, both internal and external.

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MANUFACTURING EXECUTION

How to execute flawlessly and deliver products on time with superior quality?

Manufacturing operations management (MOM) has a broader scope than manufacturing execution systems (MES) as it involves automating, executing and managing the performance of all business processes relevant to manufacturing execution, which includes manufacturing production, quality, warehousing, the workforce and maintenance. The ability to manage all of this on a single platform provides many advantages:

- ✓ **Visibility for production operations to promptly carry out unplanned maintenance**
- ✓ **Quality events can trigger maintenance alerts and move work in progress**
- ✓ **Can immediately identify a need to requisition materials or replace components**
- ✓ **Visibility that allows management to respond faster to unplanned events**
- ✓ **Eliminates silos and rogue applications**
- ✓ **Reduces risks and increases operational flexibility**



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Manage and connect all elements of manufacturing operations

Machine integration enables the MOM solution to connect to all machines and devices in the physical world through IIoT. Open standards for connectivity—both directly and through partner hardware and software—empowers the MOM solution to work across all operations. This drives better compliance with regulatory requirements, enforces best practices and enables lean operations.

Creating that IIoT connection between the physical world and MOM solutions can be challenging for companies, but it makes up a key part of the Virtual Twin Experience philosophy. The connectivity enables closed-loop synchronization of the virtual and real worlds, which drives productivity, provides complete real-time visibility, enables predictive maintenance and improves product quality.

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Manufacturers typically find it a challenge to realize this connectivity as the array of software and technology they rely on often use different communication standards that do not translate well between systems. There is no single medium that is universally accepted as the industry standard. Incompatibility between legacy machines and newer systems makes this even more difficult.

DELMIA adopts an open and agnostic approach to these challenges. With no stake in the hardware game, our approach is to adopt widespread industry standards and utilize a one-size-fits-all solution that can work with all forms of hardware; working with partners to ensure that all systems are able to connect with the **3DEXPERIENCE** platform.

With the arrival of 5G, new connectivity standards have created powerful new possibilities for manufacturers through the Virtual Twin Experience. Low latency enables instant response for time critical applications while the drastically improved data rate enables everything from augmented reality to virtual reality and 4K streaming at 10 times the speed. This increased capacity for connections will enable bigger and more complex operations, making 5G the true enabler of the smart factory.

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Many companies have found great success in leveraging the **3DEXPERIENCE** platform to optimize their operations. Here is one story from Canadian industrial automation process and technology company **CenterLine (Windsor) Limited**, a producer of custom automated welding and assembly lines:

THE CHALLENGE

- Factory setups can be very expensive, especially when a manufacturer needs to fix design errors after built-out systems have already been physically installed.
- Careful planning is required to avoid operational errors or accidents between machines and human workers.

STRATEGY

- CenterLine sought to optimize their robotic work cell designs through digital simulation before the actual deployment of physical equipment on factory floors.
- They implemented DELMIA on Dassault Systèmes' **3DEXPERIENCE** platform to virtually simulate products, processes and factory operations for optimized robot movements, plant layout, material flow and ergonomics.

RESULTS

- Since implementing DELMIA for every robotic work cell, CenterLine has **reduced tooling-related issues and rework** by up to **90%** and **programming time on the floor** by up to **75%**.
- Time saved through simulating robot arc welding tool paths has **improved productivity by 15%** and **shortened the time to market** for simulation and design by **15-20%**.
- As a single source of truth for different CAD data, **3DEXPERIENCE** allows leaders at CenterLine to **focus on day-to-day operations** instead of managing data and products.

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[Click here](#) to read the full customer story.

REALIZING THE VIRTUAL TWIN EXPERIENCE IN MANUFACTURING

Transitioning to a Virtual Twin Experience represents a profound shift in manufacturing decision-making. Dassault Systèmes Strategic Business Development Director, **Adrian Wood** breaks down the Virtual Twin Experience into four distinct parts:

- COLLABORATION**
is where organization stakeholders determine the needs, wants and goals of the project. Design engineering, manufacturing engineering, quality assurance, sales, procurement and management all contribute to the creation of a unified system in manufacturing operations for any industry.
- MODELING**
is the starting point for digitalization, creating an accurate representation of machines, processes and workflows. Accuracy must be maintained throughout the project; ad hoc or emergency changes to equipment or processes must be reflected in the models, which helps managers test solutions before implementation.
- OPTIMIZATION**
is the payoff from the Virtual Twin Experience, where changes are tested virtually to eliminate bottlenecks and improve efficiency. This is where planning changes become true “what if” experimentation—on everything from equipment cycles to worker time and motion study.
- PERFORMANCE**
is the goal; the actual implementation of new processes and procedures tested in the virtual factory. With a successful Virtual Twin Experience, production changes are swift and trouble-free, and downtime is minimized. Equipment with sensors then feed real-time data back to the twin to confirm outcomes and establish a new baseline for the next series of experiments and improvements.

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Shortened production cycles enable manufacturers to keep up with accelerating market demands for products made with the latest innovations. Manufacturers can also plan within changing regulatory constraints and create optimal facility layouts that allow them to keep up with the proliferation of product variants while working with limited assembly lines and resources.

Flawless execution allows manufacturers to get it right the first time in manufacturing new products without wasting precious time and money on multiple physical prototypes, which also reduces waste and enables sustainable manufacturing. Further optimization can make operations and supply chains resilient to disruption from resource scarcity.

Manufacturers have an opportunity to optimize operations and maximize returns by leveraging the endless possibilities of the Virtual Twin Experience, powered by the **3DEXPERIENCE** platform. Through enhancing processes and the cohesion between design, engineering and manufacturing, manufacturers can achieve the agility and synchronization necessary to make their business more competitive.



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Learn more about our solutions for manufacturing at:

<https://www.3ds.com/manufacturing>

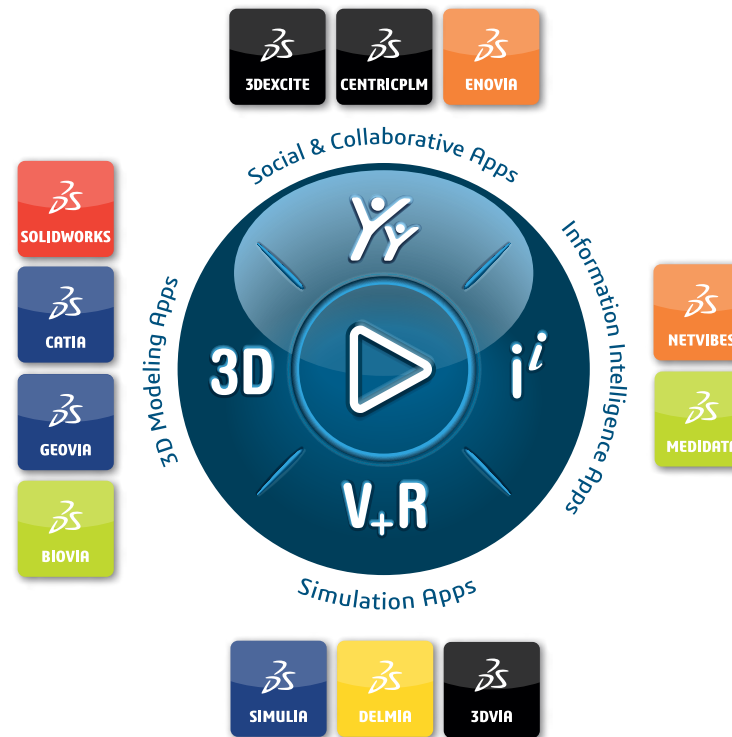
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Our **3DEXPERIENCE®** platform powers our brand applications, serving 11 industries, and provides a rich portfolio of industry solution experiences.

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Dassault Systèmes' 20,000 employees are bringing value to more than 270,000 customers of all sizes, in all industries, in more than 140 countries. For more information, visit www.3ds.com.



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THE INDUSTRY THAT DRIVES INNOVATION

KEY CHALLENGES IN MANUFACTURING

KEY TRENDS IN MANUFACTURING AND OPERATIONS

SEVEN ADVANTAGES OF THE VIRTUAL TWIN EXPERIENCE IN MANUFACTURING

THE VIRTUAL TWIN EXPERIENCE

INNOVATION TIME HORIZONS

- Facility Planning
- Process Planning
- Manufacturing Planning
- Manufacturing Execution

MAJOR IMPROVEMENTS THROUGH THE VIRTUAL TWIN EXPERIENCE

REALIZING THE VIRTUAL TWIN EXPERIENCE IN MANUFACTURING