BEYOND DIGITAL TWIN:

Small and medium-sized manufacturers enjoy big-enterprise benefits and ROI with Virtual Twin Experience on the cloud.

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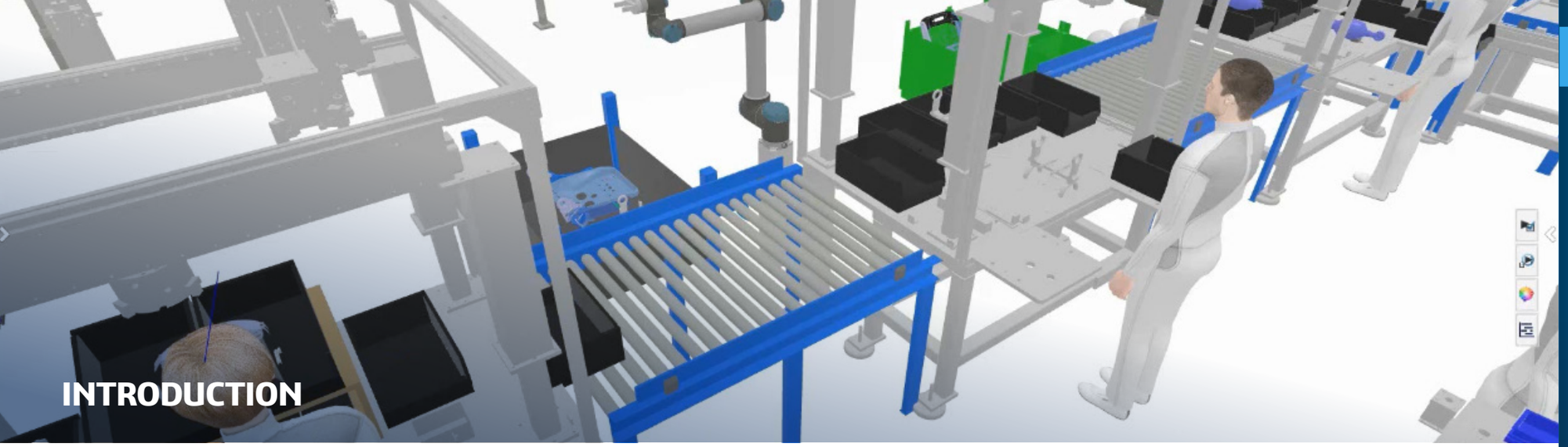
DASSAULT SYSTEMES



INTRODUCTION

In manufacturing, bigger is better. In the 20th century, that truth was self-evident: economies of scale and lower unit costs were proportional to the production run, and this spawned some of the most famous industrial concerns of the century, such as VW, Toyota and General Electric.

In the 21st century, however, the manufacturing landscape is changing. Tools and technologies formerly restricted to large operations are becoming more affordable and accessible to small and medium-sized manufacturers. Large manufacturers traditionally had scale advantages in computing, while smaller companies were limited to the power of their computers and knowledge.

Cloud-based engineering solutions remove this barrier and add data continuity, an added safety factor where data is increasingly the most valuable asset in the business. This means lower costs, better profitability and faster time to market for firms ready to embrace advanced technology.

Digital renderings of component parts, assemblies and fixturing are nothing new to 21st century manufacturers. Today, even small operations use integrated CAD/CAM systems and G/M-code to program production equipment—everything from multi-axis machining centers to pick-and-place robotics.

This digitalization of the workplace, however, has been ad hoc and distributed. Design, manufacturing, production planning and MRO frequently operate as independent "silos" within the organization. But what if this data could be aggregated and expanded to allow total process simulation of an actual production process? The potential for new insight into operations is obvious, and it's used every day in large manufacturing businesses. It's called the Digital Twin.

> Proactive flexible production system. This is going to be a game changer and it's going to be a catalyst for elevating industrial operations of every size and shape, whether they are SMEs, OEMs or owner-operators.

Prashanth Mysore
Director of Global Strategic Business Development Dassault Systèmes

So, let's focus on small and medium-sized enterprise and how do we transform them, and take them on this journey.

That journey isn't simply about software; it's about a new way of thinking about process improvement in manufacturing. Large corporations have used expensive research teams to think about process improvements, expansion and new technologies.

Many use special assembly lines to test innovation, but most manufacturing enterprises are smaller. These smaller enterprises simply can't afford to suspend production in order to experiment with new technology or line configurations. A digital twin of the production process allows those companies to test, alter and test again—virtually.

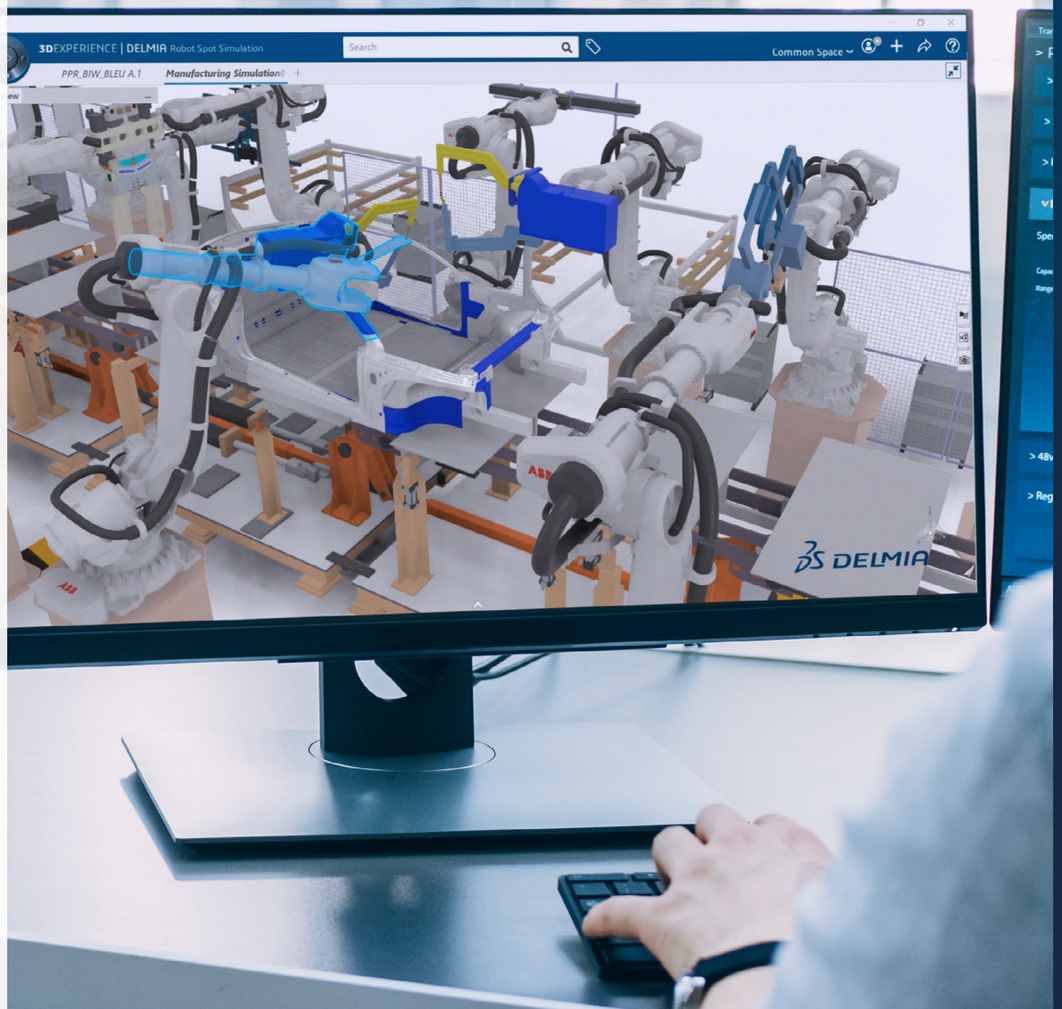
ADVANTAGES OF DIGITAL TWIN FOR MANUFACTURERS

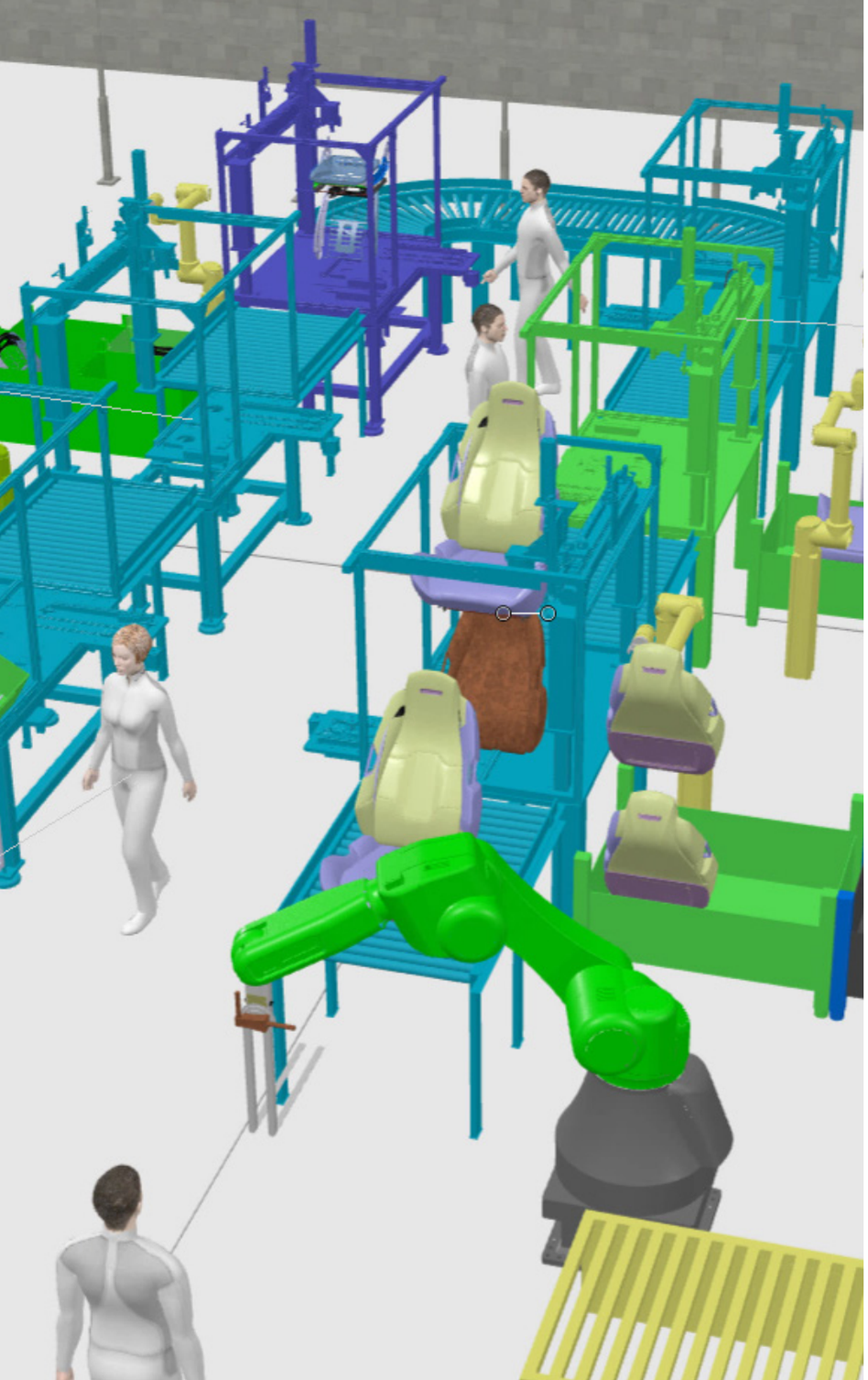
UNLIMITED ITERATIONS

Traditionally, there were two ways to improve a manufacturing process: analyze/implement or iterate/experiment.

Smaller manufacturers, without the luxury of dedicated R&D lines, were usually restricted to the former, and were often forced to make hard decisions about the time and money needed to generate an improvement.

A digital twin allows small and medium-sized manufacturers to run "what if" experiments in the virtual factory, trying different techniques and technologies to see what works and what doesn't. Production managers and engineers can develop a high degree of confidence in a new configuration before the expensive (and historically risky) step of interrupting production to make a change.





BETTER INSIGHT

Many profitable SME's run at or near capacity, but when running at full speed, where are the production bottlenecks? Is throughput machine limited or human-determined?

In fully automated assembly, it is easy to determine efficiency—either the line runs at design speed, or it doesn't. But in small and medium-sized operations, automation is usually mixed with human workers. Are these workers deployed to compensate for production bottlenecks? What happens if automated equipment runs faster?

Take machine tending, for example. A common use for CNC (Computer Numerical Control) machine tools is part production from blanks or forgings. A human tender may load and unload one or multiple machines on an assembly line, but a new machine may operate with a faster cycle time. Can the tender keep up? Or will the human become the limiting factor in the system cycle time?

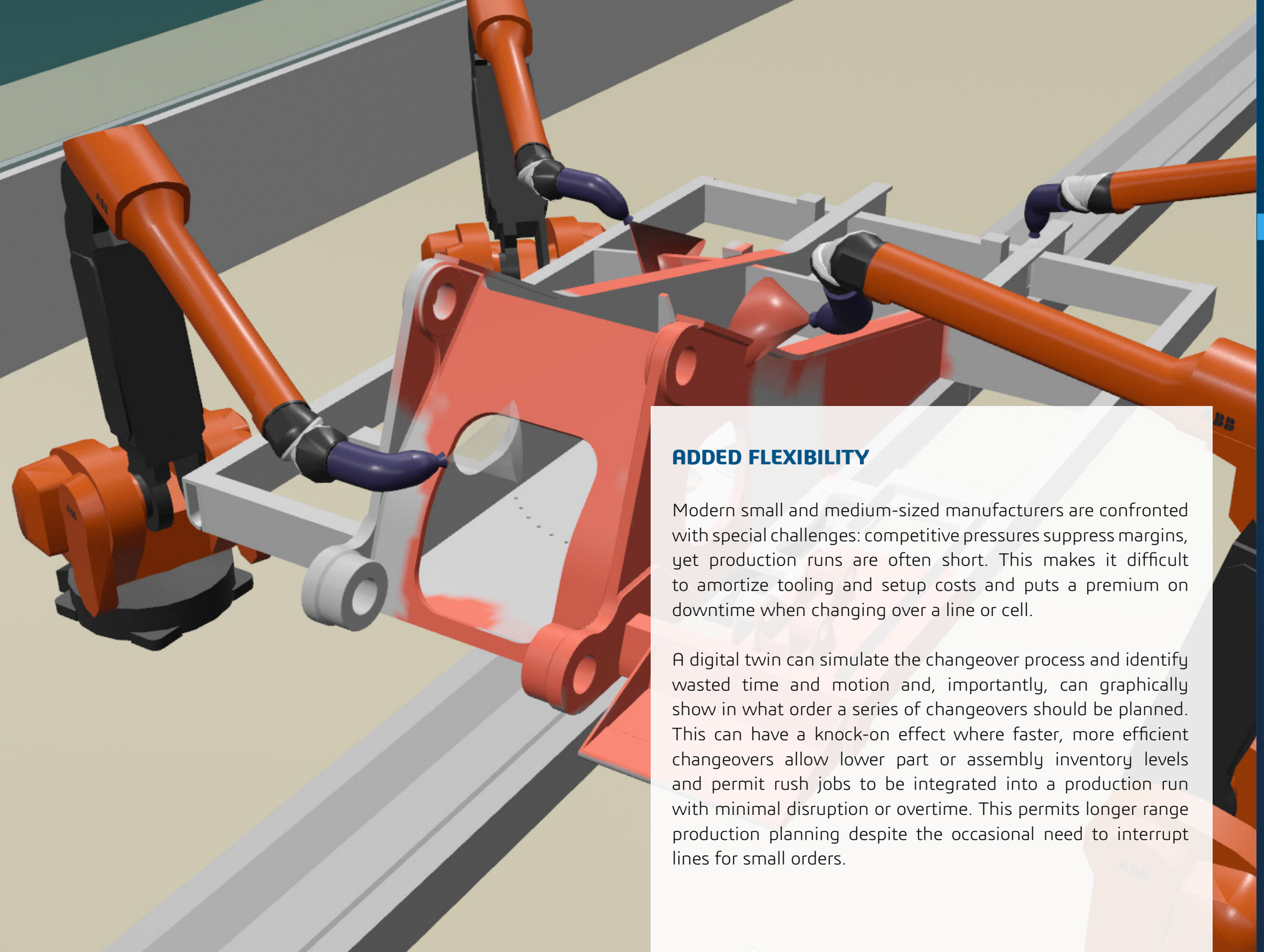
A digital twin can simulate the motion of the worker and how he or she interacts with machines. In this example, the lowest overall cycle time may be limited by the ability to load and unload parts. For the same capital expenditure, a slower, lower cost machine might allow the purchase of automation for loading and unloading, at greater overall efficiency. Slower machining time might allow greater throughput. A digital twin can uncover the optimum balance and allow the manager to specify exactly the performance requirements before shopping for new equipment.

IMPROVED HUMAN FACTORS

Workplace safety is a combination of common sense, government regulations and labor relations. Unsafe working conditions may be immediately apparent to an employee or safety inspector, or may only become apparent after an incident.

Enforcing social distancing is part of ensuring a safe workplace in the new normal. Manufacturers must evaluate how workers move through the facility and identify potential areas where social distancing won't be possible. With a digital twin, they can create a safety envelope around each worker to simulate social distancing and the flow of worker movements through the plant. As a result, manufacturers can adhere to health and safety regulations for workers regardless of country.

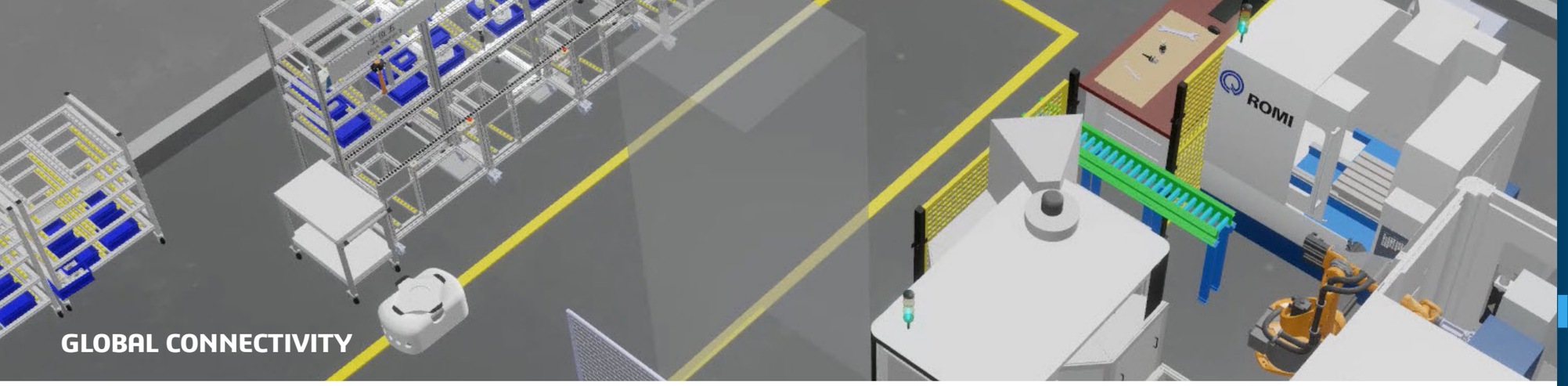
Similarly, workplace issues not directly related to immediate safety can be examined. Will an assembly task create a repetitive strain injury? Can a worker perform a task while seated? Are controls readily accessible? The potential for better employee health is clear, and issues are easy to correct in simulation. A further benefit is the ability to record company efforts to improve worker health and safety through the software. In labor negotiations or during a regulatory inspection, the ability to demonstrate that issues were considered, and problems addressed can be invaluable.



ADDED FLEXIBILITY

Modern small and medium-sized manufacturers are confronted with special challenges: competitive pressures suppress margins, yet production runs are often short. This makes it difficult to amortize tooling and setup costs and puts a premium on downtime when changing over a line or cell.

A digital twin can simulate the changeover process and identify wasted time and motion and, importantly, can graphically show in what order a series of changeovers should be planned. This can have a knock-on effect where faster, more efficient changeovers allow lower part or assembly inventory levels and permit rush jobs to be integrated into a production run with minimal disruption or overtime. This permits longer range production planning despite the occasional need to interrupt lines for small orders.



GLOBAL CONNECTIVITY

It's a global marketplace for manufacturers, but expertise has traditionally been limited to what a professional could see for himself or herself on the shop floor. It is possible to share drawings and even video of operations with experts around the world, but illustrating what a line or process should be is more difficult.

A digital twin in a cloud-based hardware/software environment allows experts located anywhere to add useful insight into factory processes. Consultants, engineers from overseas divisions and engineers working remotely can all contribute and demonstrate their ideas in animation, allowing senior managers to approve changes and try ideas with more input from more experts than would be possible through static CAD-based renderings.

Another advantage of using a digital twin is the ability to analyze how changes to factors external to the production process affect productivity. For example, a common way to reduce cost in injection molding operations is to use hopper loaders fed from a central resin storage tank. Vendors bidding on a major project to upgrade an in-plant distribution system could be invited to use the digital twin to determine the proper equipment capacity and layout in the plant before a site visit.

Similarly, shipping completed goods may be more cost effective if containerized. How would the goods be handled to consolidate full container loads? Would additional warehousing space be needed? Racking? Forklift access? These and many other considerations can be tested with a digital twin before an expensive commitment is approved.

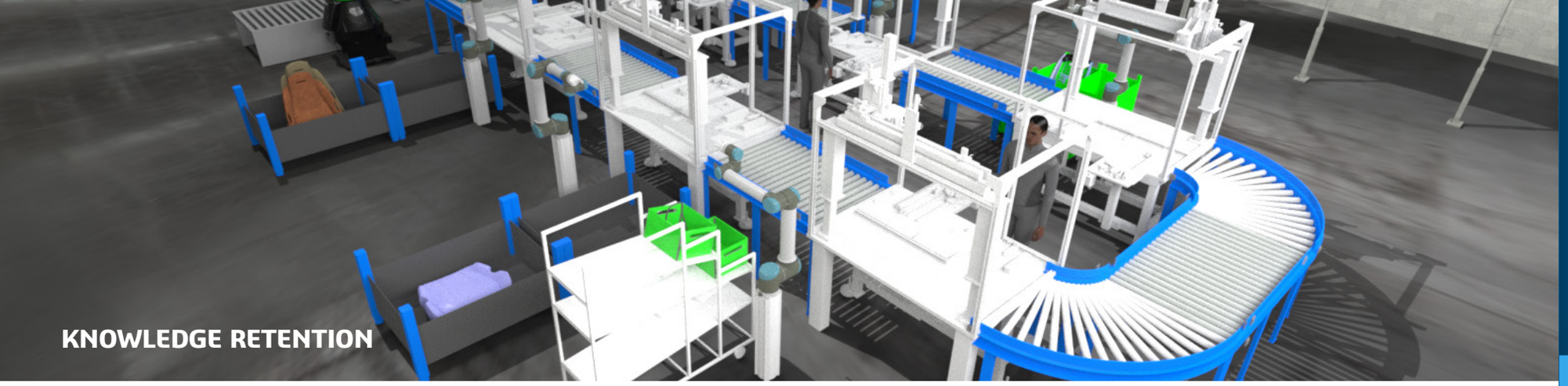
Cloud-based global collaboration carries security risks and good platforms have security built into their code. According to Mysore, "That's a key differentiator of the **3D**EXPERIENCE® platform on the Cloud. The concept of "Security in Depth" at Dassault Systèmes relies on the fact that several independent mechanisms are put in place in order to mitigate any single risk and follows industry standards and best practices, where practical and applicable. When it comes to application security, the platform includes comprehensive access controls and authentication, including the availability of two-factor authentication. And all communications are done through a secure sockets layer, transport layer security channels with 128-bit encryption."

SENSOR INTEGRATION

Most modern production equipment today is sensor-driven and generates large quantities of data in real time. Much of this information is used for simple analysis for quality control or production monitoring, but a digital twin can be harnessed to make modern factory operations truly transparent to engineers and managers.

For SMEs, the ability of a digital twin implementation to take physical systems and data streams into the virtual world is critical. If the virtual representation lags the actual physical operation, the ability to plan and model is degraded, and costs increase.

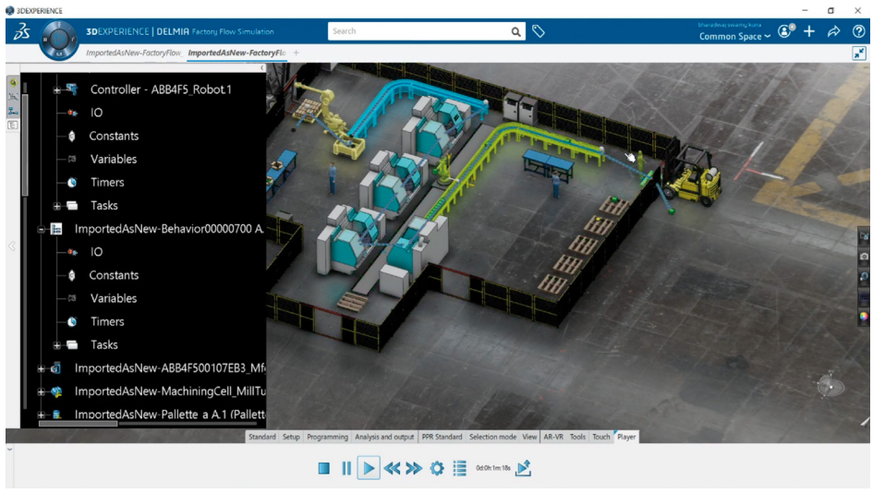
> “How do we connect this 3D model into real operations with the Industrial Internet of Things and sensors? Today, sensor-driven manufacturing is just like cyber physical systems. Production processes are driven by sensors, robots are driven by sensors and part-handling is done with sensors. How do we really connect those physical systems into virtual systems? This is where **3D**EXPERIENCE platform comes to the picture.



KNOWLEDGE RETENTION

Older manufacturing operations often have processes and employees with vast amounts of institutional knowledge. Losing key personnel has long been a problem for SMEs and this now extends to technology with storage formats becoming obsolete and translation of code being difficult from legacy equipment.

Cloud by definition enables integrated data continuity; digital twin institutionalizes enterprise knowledge before this becomes a problem and ensures continuity in the event of a key loss, whether human or material.



VIRTUAL TWIN EXPERIENCE

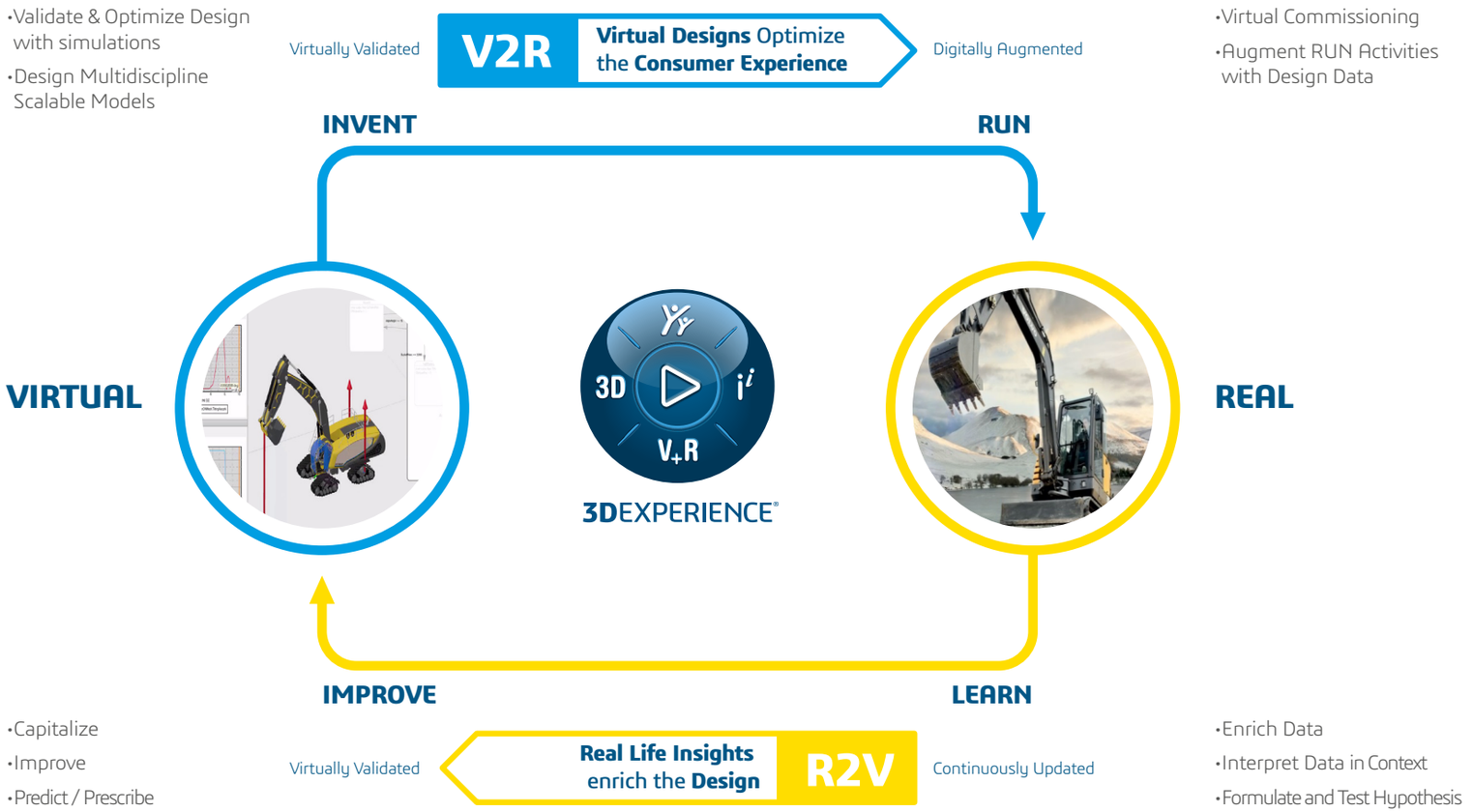
Virtual Twin Experience is an executable virtual model of a physical system which brings in learning and experiences taken from the REAL world processes to update the digital twin model.

Achieving this closed-loop capability is the full realization of benefits to be gained from the convergence of the virtual and real worlds.

Achieve Sustainable Innovation and Excellence

Support Creation of Value Network

Empower the Workforce of the Future



FOUR STEPS TO SUCCESSFUL VIRTUAL TWIN EXPERIENCE REALIZATION

The benefits are many, but how should an SME approach the problem?

Mysore makes the transition to a Virtual Twin Experience sound like a religious experience and done correctly, it can and does represent a profound shift in manufacturing decision-making. He divides a Virtual Twin Experience into four discrete components: collaboration, modeling, optimization and performance.

Collaboration is the process by which the different stakeholders in the manufacturing organization gather to work out the needs, wants and goals of the overall project. Design engineering, manufacturing engineering, quality assurance, sales, procurement and management all may have useful input into the creation of a unified system.

Modeling is the starting point for digitalization. It is the rendering of physical systems (and often humans, too) to create an accurate representation of machines, processes and workflows.

Accuracy here is essential, and it must be maintained throughout the life of the project. Ad hoc or emergency changes to equipment or processes must be reflected in the models, a task made easier as managers develop trust in the systems to test solutions before they're "cut into metal." This process might be difficult and time consuming, but there are ways to speed up the modeling process.

> "Where Dassault Systèmes' partners have helped companies is with scanning. Our ecosystem partners will do a complete scan of your existing resources, existing layout, and existing physical resources and download that into a 3D physical model. We also have catalogs of CNC machines, robots, conveyors and others in a Virtual Twin Experience form. With the help of these catalogs, one can manually build the layout. If you think that scanning is a laborious affair, it isn't anymore.

Optimization is the payoff from the Virtual Twin Experience, the process where changes are tested, tried virtually and tested again to reduce production bottlenecks and improve efficiency. This is where planning changes become true "what if" experimentation, iterating many changes in real time, from equipment cycles to worker time and motion study.

Performance is the goal of the digital twin, the actual implementation of the new processes and procedures worked out in the virtual factory. With a successful the Virtual Twin Experience, production changes are swift, trouble-free and downtime is minimized. Sensor-equipped equipment then feeds real-time data back to the twin to confirm outcomes and establish a new baseline for the next series of experiments and improvements.

Challenge: Canadian industrial automation process and technology company CenterLine (Windsor) Limited aimed to optimize robotic work cell designs through digital simulation prior the deployment of physical equipment on factory floors.

Solution: CenterLine 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% – delivering on-time, on-budget solutions while enhancing customers' business competitiveness.

> "Our customers value the fact that we're going to give them good equipment but also they're looking for us to provide systems that are going to make them competitive and keep production going.

Marc Levesque
Director of Corporate Marketing,
CenterLine (Windsor) Limited

IS MY BUSINESS RIGHT FOR A VIRTUAL TWIN EXPERIENCE?

Every major change in capital equipment or process in a manufacturing operation needs a strong business case, regardless of size. "What are we trying to achieve here? What is the first business case?" Mysore states.

"Let's imagine the first business case of a Virtual Twin Experience is to optimize the efficiency of workers or to improve overall equipment effectiveness. We need to define these kinds of use cases, and start to implement small. They like the benefits, and then we add on more use cases. We enhance the basic digital twin with Virtual Twin Experience. It's not a static digital twin. Virtual Twin Experience is an executable virtual model of a physical system which brings in learning and experiences taken from real-world processes to update the digital twin model. SMEs can not only improve but unleash new business creativity from a point of in-depth manufacturing knowledge. Achieving this closed-loop capability is the full realization of benefits to be gained from the convergence of the virtual and real worlds," said Mysore.

"That's our approach, and then we also have a methodology called value engagement. It gives all implementers, irrespective of size, a roadmap for implementing a Virtual Twin Experience."

In essence, Mysore is describing a kind of recursive process, where the act of implementing a Virtual Twin Experience helps small and medium size firms with their implementation.

In an increasing number of cases, implementation comes at the urging of a major OEM customer, often in the aerospace, automotive or industrial equipment industries. "When a major customer such as a major airframer requests their suppliers to be on the same platform, on a similar technology, it is an opportunity for SMEs to be on the same platform and learn from the new Virtual Twin Experience transformation products," Mysore relates.

"That's a great opportunity for the supply chain, but we don't want to overload small and medium-sized enterprises with one 'big bang' approach if they're not ready for major transformation. Of course, they may be instructed or requested by OEMs to be on a single platform. Either way, we can help. Our cloud hardware/software environment helps SMEs on their individual digitalization journey, and also supporting the OEM customers."

> “Our Smart Factory initiative will continue going forward. We hope to make Kobelco’s presence a strong one by achieving the ideal state of manufacturing through the utilization of Dassault Systèmes solutions and by accumulating accomplishments we will serve as a fountain of best practices to others in the manufacturing industry with similar challenges and aspirations.

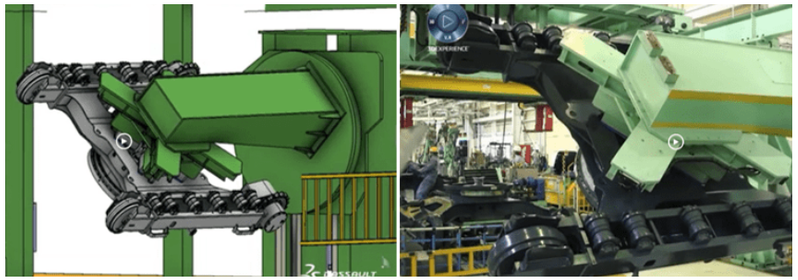
Yoshiaki SHISHIDO
Leader of Shovel Mass Production Preparation Group, Manufacturing Promotion Department, Production Division, KOBELCO CONSTRUCTION MACHINERY

THE CHALLENGE

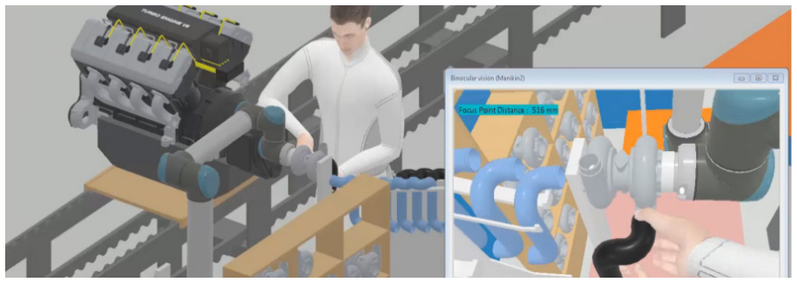
In the fast-moving and changing construction industry, businesses have to be adaptable to change. To meet this challenge, KOBELCO CONSTRUCTION MACHINERY developed their Smart Factory initiative based on three functional pillars; **Process Standardization, Virtual Assembly Verification** and Unified **Plant Management Information**. The combination of these three functional pillars allows manufacturing to be executed with the best QCD (quality/cost/delivery).

THE SOLUTION & BENEFITS

In order to reduce the rework in product development, the company implemented process planning and 3D simulation simultaneously using DELMIA solutions. DELMIA supports the industrial engineering processes all the way through their execution processes in the factories to create the Virtual Twin Experience. Thereafter, DELMIA solutions were implemented in order to execute manufacturing processes and collect performance information from the manufacturing sites so that deviations from standards can be analyzed and improvements implemented.



- **Product development lead-time cut**
  The product development lead-time was reduced by 50%



- **Reduced design rework and production design changes**
  A 3D virtual assembly verification enabled a reduction of design rework by 60%

- **Reduced back office operations**
  Setting up an optimal operation process enabled a 50% reduction in back-office staff operations

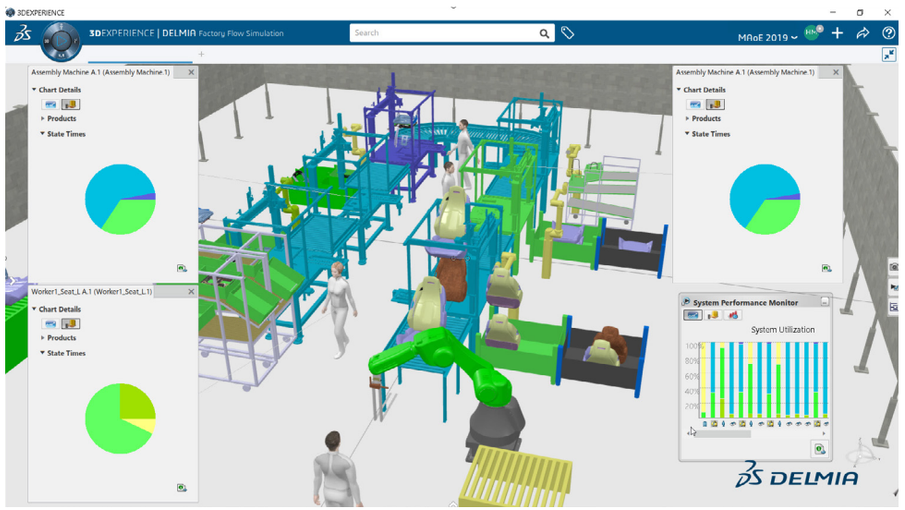
I'VE IMPLEMENTED A VIRTUAL TWIN EXPERIENCE. HOW DO I KNOW IT'S WORKING?

It's a major step for an SME to implement leading-edge technology to business-critical operations. The goal is always better performance, but how is this best measured?

According to Mysore, "I like to classify validating these KPIs or returns on investment into three buckets. The first one is in the resources themselves. It can be equipment or manpower. Are we seeing an improvement in uptime of a machine or productivity, or improvement of effectiveness of a machine in between failures? Then the second one is at the company level, or at the departmental level where we have a complete line utilization. Does it utilize one hundred percent? Can we introduce multiple models? Can we do advanced configuration management, and all those things on an existing line?"
Mysore's third "bucket" isn't measurable a KPI, or MTBF. It's intangible, but just as important as any metric. "It has all the ingredients for the workforce of the future. For these younger workforce who want to take up jobs in manufacturing, the **3D**EXPERIENCE platform supports them. It's imaginative, immersive, collaborative, and predictive—all the ingredients of what a younger workforce really expects. That's a key differentiator for me. You're reducing attrition, you're improving the quality of learning for new workers or new engineers or even existing workers."

Ask most small and medium-sized manufacturers and they'll agree: profitability is about the efficient use of technology, sensible pricing and cost control. As quality demands tighten and margins compress along with lead times, a Virtual Twin Experience will be as essential to 21st century operations as CAD/CAM.

It really comes down to simple principles. The backbone of manufacturing is the small and medium-sized. Virtual Twin Experience on the cloud gives them a huge opportunity to optimize their business processes.



To get more information about cloud-based Virtual Twin Experience for manufacturing or to evaluate an outcome-based model of the Virtual Twin Experience, please contact us

Inceptra

Inceptra supports engineering and manufacturing organizations with best-in-class solutions to digitally design, simulate, produce, and manage their products and processes, enabling enhanced innovation and productivity.

As the largest Platinum partner in North America, Inceptra is dedicated to Dassault Systèmes' product development software portfolio, complementary solutions, and related services, including training, implementation, integration, support, consulting, and automation services. For more information, please visit Inceptra.com.

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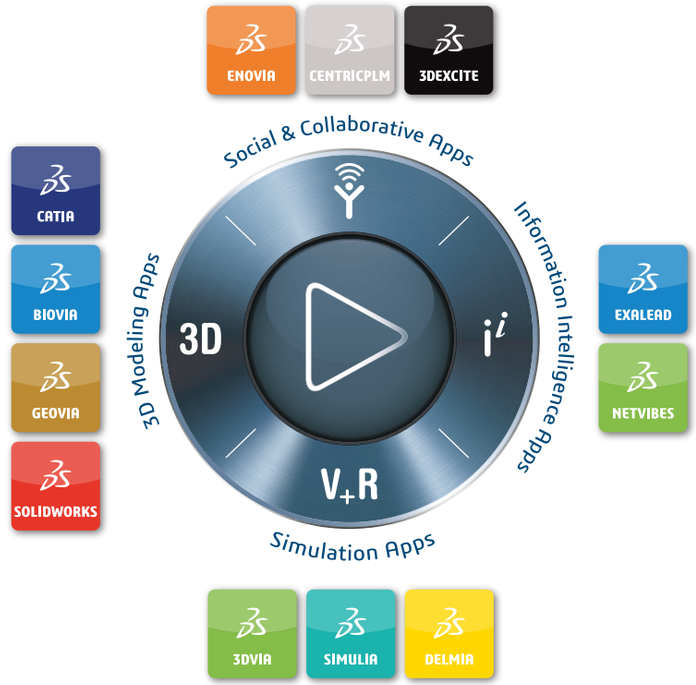

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