

# HOW AR/VR TECHNOLOGY IMPACTS THE MANUFACTURING LABOR CRISIS



Digital transformation has become a significant priority for manufacturers. Data tells us that a single issue has bubbled to the top of transformation priorities for many industries: the Manufacturing Labor Crisis. This White Paper addresses the manufacturing labor crisis and how key manufacturers mitigate it with augmented reality/virtual reality (AR/VR) tools. AR/VR technologies directly impact knowledge capture, training, retention, and the labor productivity improvements needed to cope with the Manufacturing Labor Crisis. AR/VR is a critical component of the future of industrial work. In addition, they are “force multipliers” to accelerate digital transformation more generally.

## THE MANUFACTURING LABOR CRISIS

You probably know the pain of the Manufacturing Labor Crisis, but you may not know the numbers. The U.S. National Association of Manufacturers reports that 77% of manufacturers say they have ongoing difficulties in attracting and retaining workers in 2021 and beyond. Moreover, finding the right talent is now 36% harder than in 2018, even though the unemployment rate has nearly doubled the supply of available workers. They go on to say:

**“The manufacturing skills gap in the U.S. could result in 2.1 million unfilled jobs by 2030, according to a new study by Deloitte and The Manufacturing Institute, the workforce development and education partner of NAM. The cost of those missing jobs could potentially total \$1 trillion in 2030 alone.”<sup>1</sup>**

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**“...it is deeply concerning that at a time when jobs are in such high demand nationwide, the number of vacant entry-level manufacturing positions continues to grow,” said Paul Wellener, Deloitte vice chairman and U.S. industrial products and construction leader. “Attracting and retaining diverse talent presents both a challenge and solution to bridging the talent gap.”**

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<sup>1</sup> NAM News Room May 4, 2021 “2.1 Million Manufacturing Jobs Could Go Unfilled by 2030” <https://www.nam.org/2-1-million-manufacturing-jobs-could-go-unfilled-by-2030-13743/>





Driven by the retirement of the Baby Boomer and GenX generations, the “Great Resignation” associated with the COVID pandemic, and the uneven attractiveness of manufacturing as a career opportunity for Millennials, manufacturers are faced with profound and growing labor shortages. As a result, manufacturers are challenged simply in recruiting, retaining and engaging workers in their factories.

We, and an increasing number of manufacturers, are calling it the Manufacturing Labor Crisis because personnel shortages are only one of many dimensions of the labor problem. This shortage is exacerbated by the high levels of turnover in new hires with many manufacturers. They report as much as 50% of new hires leave before their six-month anniversary date (accelerating a long-standing trend that low-wage positions have 50% turnover within three years across industries<sup>2</sup>). In short, experienced workers are leaving their jobs, and new hire retention is low with significant turnover. There are several reasons why workers leave so quickly, but multiple studies have found many workers forsake jobs because they feel ill-prepared for the expected work. For example, only 26% of employees in an Accenture survey strongly agree that their employer prepares them for the future skills necessary.<sup>3</sup> Even the best employers with robust training programs face the reality that new workers will likely never have the deep “tribal knowledge” of those experienced workers lost.

Confounding and amplifying the labor challenges is that manufacturing jobs are increasingly complex high-skill and high-tech. The future of industrial work is likely uniquely different than the processes and operations of the last 200 years. Manufacturers may understand the problem but have not invested in solving the problem. The Manufacturing Institute found that “75% of industrial organizations identified reskilling the workforce as important or very important for their success over the next year, but only 10% said they were ready to address this trend.”<sup>4</sup>

**All in all, what we are calling the Manufacturing Labor Crisis has 4 dimensions:**

<p><b>1</b></p> <p><b>Experienced workers are leaving manufacturing in droves</b></p>	<p><b>2</b></p> <p><b>Manufacturers are having great difficulty hiring replacements</b></p>	<p><b>3</b></p> <p><b>Replacement hires do not have the expertise of the workers they are replacing</b></p>	<p><b>4</b></p> <p><b>Keeping and onboarding new hires is challenging and requires investment/focus</b></p>
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<sup>2</sup> Joseph B. Fuller and Manjari Raman “Building from the Bottom Up” Harvard Business Review February 28th, 2022 <https://www.hbs.edu/managing-the-future-of-work/research/Pages/building-from-the-bottom-up.aspx>

<sup>3</sup> Marc Carrel-Billiard, Dan Guenther, Nicola Rosa, and Krista Taylor Accenture “Immersive Learning with XR Research validates path for XR to unlock the power of human potential” 2021 [https://www.accenture.com/\\_acnmedia/PDF-164/Accenture-Immersive-learning.pdf](https://www.accenture.com/_acnmedia/PDF-164/Accenture-Immersive-learning.pdf)

<sup>4</sup> Michael Collins, Industry Week June 9, 2022 “Manufacturing’s Back Is to the Wall on the Skilled Labor Shortage” <https://www.industryweek.com/talent/education-training/article/21243760/manufacturings-back-is-to-the-wall-on-skilled-labor>

# AR/VR DELIVERING VALUE

The Manufacturing Labor Crisis cannot be addressed with business as usual. Increasing wages, finding experienced workers, remote locations, and portraying manufacturing as an attractive industry are often not possible or effective enough. Manufacturers are therefore looking at re-architecting their training programs and how they execute manufacturing to reflect their new reality. Technology is key to meeting the Manufacturing Labor Crisis.



AR/VR is one of the vital technologies being deployed to combat the Manufacturing Labor Crisis. The technology offers powerful immersive training to accelerate “door-to-floor” efforts. 3D models can be used with augmented reality to help close the skills gap created by the departure of more experienced personnel. Empowering operators positively improves job satisfaction and increases retention. AR/VR has become a fundamental building block in the future of industrial work. And AR/VR becomes a “force multiplier” to other transformation initiatives as it enables new processes and operationalizes digital technologies. Let’s look at each of these in succession.

## IMMERSIVE TRAINING TO ACCELERATE “DOOR-TO-FLOOR” CAPABILITIES

Training of manufacturing personnel has always been problematic. As referenced earlier, manufacturers are not investing in training. If they are, they typically invest in the wrong training forms.

**Despite spending an average of \$1,300 per employee annually on training, research proves that learners forget 70% of the content within 24 hours and nearly 90% in a month. So it’s not surprising that over 90% of executives surveyed agree existing employee training methods need to be more effective for their workforce.<sup>5</sup>**

Sitting new hires in a classroom to listen to an instructor drone on or to take computer-based training courses is not making the impact that companies need to quickly get effective and qualified workers on the line. Science demonstrates that training employees now means going beyond one-way training experiences to engage all the human senses. Typically, the more active the learning, the more effective the outcomes. Immersive learning, an advanced form of active learning, uses technology to create fully simulated environments where learners interact with the experience—as close to the “real world” as possible. For example, in manufacturing, users can assemble products using 3D models and maintain equipment virtually. Or it means empowering new hires to operate equipment virtually and simulate manufacturing operation or control room work.



One Life Sciences company found that immersive training, using AR/VR powered by virtual twins of plant equipment and manufacturing processes allowed them to reduce training for new hires from six months to only one month. This reduction in the “door-to-floor” time it took to train operators was accomplished in a highly regulated manufacturing environment where operator certification is fundamental.

Link Footnote:  
Patrick Fetterman, LNS Research “IX in Regulated Industries. Some Sectors Polar Opposites” <https://blog.lnsresearch.com/ix-in-regulated-industries-some-sectors-polar-opposites>

<sup>5</sup> Marc Carrel-Billiard, Dan Guenther, Nicola Rosa, and Krista Taylor Accenture “Immersive Learning with XR Research validates path for XR to unlock the power of human potential” 2021 [https://www.accenture.com/\\_acnmedia/PDF-164/Accenture-Immersive-learning.pdf](https://www.accenture.com/_acnmedia/PDF-164/Accenture-Immersive-learning.pdf)

Once considered a very specialized tool, virtual reality has caught the interest of industries looking to train their staff more effectively. The advantages of 3D-driven training include the following:



**A more realistic training experience that engages frontline personnel more directly and holistically**



**Supports the development of skills that are difficult to impossible to explain verbally**



**Eliminates the need to create physical mock-ups of control rooms, plant equipment or product sub-assemblies**



**Accelerates learning and provides easy mechanisms to reinforce learning (train anywhere, immersive work instructions, etc.)**



**Provides higher levels of trainee engagement**



**Improves reusable learning content over time and across sites**

Gartner summarizes the impact: “Immersive technology can reduce the cost and complexity of training frontline workers. It also delivers a training experience resembling real situations and develops empathy and decision-making skills.”<sup>6</sup>

AR/VR-based training accelerates learning, has a more lasting impact, and provides more cost-effective execution.

**“ Operators embrace this solution because it provides them with effective assistance in avoiding errors and completing tasks to the best of their ability.”**

Quality Manager, Dassault Aviation



©Dassault Aviation



Dassault Aviation, a manufacturer of military aircraft and business jets sought to reduce nonconformities during complex mounting assembly operations, minimize errors, and improve the quality and productivity of the Rafale wing.

### THE CHALLENGE

Before robots can begin drilling and milling on the Rafale wing, operators have to position different pins at specific locations. This is to ensure the wing is fixed correctly on the structure. However, due to the complexity of the task and changing configuration from one operation to another—the preparation process is long and extensive with a risk of error.

### THE SOLUTION

Leveraging the DELMIA Augmented Experience solution, Dassault Aviation’s operators can now visualize the pinning configuration directly on the wing thanks to the projection of the work instructions in AR. This improves instruction comprehension while minimizing the risk of errors.

<sup>6</sup> Eri Hariu, Leif-Olof Wallin, GARTNER, “Innovation Insight for Immersive Technologies in Frontline Working” 21 September 2021, [https://www.gartner.com/en/documents/4006012\\_pg4](https://www.gartner.com/en/documents/4006012_pg4)



## AUGMENTED REALITY EMPOWERS FRONTLINE WORKERS

AR/VR has significantly more impact when extended into operations. 3D models created in the design process and deployed in immersive training can be leveraged as augmented instructions in operations. Frontline maintenance, quality, and production workers are guided, step-by-step, through the tasks they need to execute with precise dimensions and instructions projected onto the work surface, displayed on a tablet or mobile device, or displayed hands free using AR technology such as HoloLens or Google Glass. In addition, data is collected as text and dimensionally meaningful graphics on top of the 3D model to improve processes, products, and the work-in-process. These immersive, augmented work instructions can build on, extend, and deliver timely reinforcement of training materials.

### MAINTENANCE

The first form of augmented instructions is in the maintenance domain. Maintenance techs receive highly visual 3D images of the equipment to be maintained. Next, reality is enhanced with 3D images to identify the specific equipment, how spare parts should be situated, what good parts should look like, and how to disassemble and re-assemble them. Maintenance techs feel empowered because they know how to do the process.

### PRODUCTION

A more powerful use of augmented reality instructions has emerged for operators in discrete industries. AR can help operators execute (operate machinery and/or assemble products correctly) in demanding environments. We all know text-based work instructions have a limited impact. Highly visual, interactive, and step-dependent work instructions intuitively guide an operator through their work. 3D models layered on sub-assemblies (directly or on a tablet) allow operators to know precisely how engineers intended the product to be made without any guesswork or tribal knowledge needed.

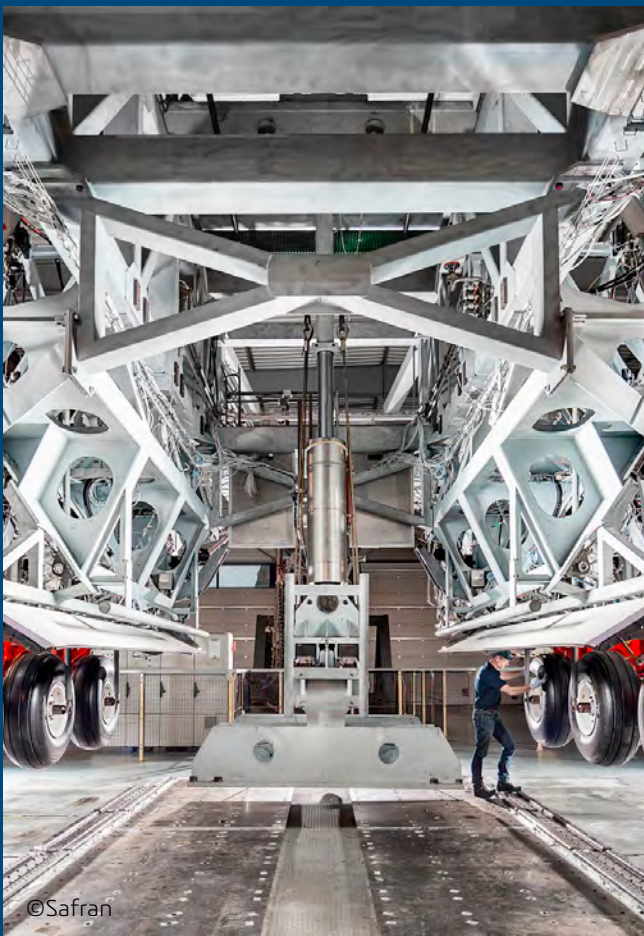
An auxiliary power plant manufacturer for airlines had a quality problem. Airline manufacturers were rejecting their engines because they looked dissimilar. Operators on their manufacturing line were using their individual creativity to determine how wire harnesses went around the engine. The source of the problem was the inability of operators to visualize how engineers preferred the wire harnesses be installed. Augmented work instructions solved the quality problem quickly.



## QUALITY

Augmented reality-based inspections create genuine business impact in quality tasks across the plant. Whether it is supplier components, quality control of unitary parts, assemblies and sub-assemblies, or final product, augmented reality-based inspections deliver powerful value. Quality control inspectors do not have to guess if they are applying the correct dimensions in the right place, whether they have found all the points of inspection required, or specific tolerances demanded at given locations. 3D-augmented inspections can quickly, meaningfully, and precisely guide the inspection process.

Overall, augmented reality inspections and quality testing are particularly impactful in environments with high degrees of product complexity and variability. For example, 3D-augmented work instructions are especially effective in highlighting the stages of assembly, drilling diameters, type of rivets, type of supports to be assembled, etc., as they are digitally superimposed on the actual part to guide the operator step-by-step during assembly. As a result, frontline workers can execute with confidence the exact requirements for a specific task without the confusion inherent in deciphering text instructions and interpreting intent. In certain scenarios, inspections can be completed automatically using AI based on the 3D model, eliminating the need for a human operator to do the inspection and analysis.



Safran Landing Systems is an international high-technology group operating in the aviation (propulsion, equipment and interiors) defense and space markets. The maintenance of aeronautical equipment strictly follows specific rules and processes as defined in the maintenance manuals provided by the manufacturers.

### THE CHALLENGE

The regulatory documents detailing the official repair procedures are not easily accessible in terms of knowledge and interpretation. Operators require experience and time to properly understand the manuals especially since the equipment configuration arriving in workshops varies. In addition, workers need to prepare time-consuming intervention reports according to the regulations.

Therefore, as part of its digital transformation strategy, Safran Landing Systems sought to improve the efficiency and quality of its MRO processes.

### THE SOLUTION

Safran Landing Systems implemented an Augmented Reality solution for the incoming inspection. It allowed them to guide the operator through inspection tasks via interactive and contextualized digital instructions, as well as identify defects related to the 3D model.

## LEVERAGING REMOTE EXPERTISE

Augmented reality uniquely enables companies to leverage scarce expertise effectively. Experienced operators, technicians, and inspectors are not as critical because junior workers can leverage expertise across the corporation. Senior experts can more easily support and supervise work across multiple sites with AR/VR deployed. As Gartner notes: "Immersive technology can be useful where a skilled person can see and support the situation in real time."<sup>7</sup>



<sup>7</sup> Eri Hariu, Leif-Olof Wallin, GARTNER, "Innovation Insight for Immersive Technologies in Frontline Working" 21 September 2021, <https://www.gartner.com/en/documents/4006012> pg8



## BUILDING THE ROAD TO THE FUTURE OF INDUSTRIAL WORK

The pace of change continues to accelerate for manufacturers. Technology is an accelerant of that change. As a result, manufacturing jobs are changing with the introduction of more advanced digital technologies. We may not know precisely what the future of industrial work looks like, but we know new jobs and skills are required. In 'the future of work in manufacturing', Deloitte identified jobs that do not exist today but will become commonplace soon, including the digital twin engineer, robot teaming coordinator, smart factory manager, smart scheduler, and predictive supply network analyst, among several others.

**The Washington Post has captured key questions that every manufacturer must be asking themselves:**

**“ How can the manufacturing industry prepare for this future workplace and ready its labor force to work beside robots and advanced technologies? What are the skills that will become “must-haves” in the future workplace? What are the pathways for training and education to enable these skills? ”<sup>8</sup>**



Leading organizations are rethinking work architecture, retraining people, and rearranging the organization to leverage technology to transform business.

The paradox is as more advanced manufacturing technologies are introduced, the more critical plant personnel become. Technology can automate repetitive tasks and will increasingly be used to solve problems. Still, humans will be increasingly required to focus on value-added tasks and identify which problems to solve. The broader aim is not just to eliminate routine tasks and cut costs but to create value for customers, meaningful work for people, and empower frontline workers to make decisions. Therefore, management and workers must embrace a work environment that blends advanced technology and digital dexterity with uniquely human skills for the highest level of decision support and productivity.

AR/VR has a unique role in enabling the future of industrial work as it helps workers adapt to new technology by simulating new work environments. AR/VR can be the digital tools that make other technological innovations like vision systems, cobots, and artificial intelligence more “digestible” to the manufacturing workforce. This technology contributes uniquely to the march toward the future of industrial work because it is a logical “first step” in delivering its business value. Moreover, it can make manufacturers change-ready by reducing the burdens of technology adoption in frontline workers.

<sup>8</sup> The future of work in manufacturing, The Washington Post  
<https://www.washingtonpost.com/brand-studio/deloitte/the-future-of-work-in-manufacturing/>

## BENEFITS OF AR/VR

Let's look at those benefits. For all these frontline workers, the manufacturer went beyond using AR/VR in the training room to make it an immersive, real-time application that delivered the right information to the right person at the right time IN A FORM THAT WAS MEANINGFUL to that person. All in all, 3 overarching benefits are realized:

✓ AR/VR augmented instructions fill the gap of experienced operators' departure with their "tribal knowledge", enabling manufacturers to proceed profitably with less experienced personnel. According to the World Economic Forum: "AR technology can democratize knowledge. It is particularly important because as seasoned manufacturing workers age, their knowledge can easily be shared with more technically-focused younger workers."<sup>9</sup>

✓ Worker engagement is improved, reducing employee churn. The vast majority (94%) of today's workers say they would stay at a company longer if it invested in their career development.<sup>10</sup> In addition, operators, maintenance techs, and Q.C. inspectors feel informed, capable, and supported, increasing the probability they will stay the course with their innovative employer.

✓ Most importantly, augmented work instructions "...improve the quality of work [and] ... reduces the time required to complete tasks, improving productivity and the customer experience."<sup>11</sup> Tangible financial benefit in the form of lower scrap/rework, higher labor productivity, faster cycle times, and accelerated new product introduction (NPI) reinforces the labor benefits inherent in an AR/VR deployment. These paybacks are meaningful. Manufacturers reported savings of up to 40% faster inspections, 99% of non-conformances detected, and 30% better productivity.

AR/VR is not about deploying new technology. Instead, it is about addressing the Manufacturing Labor Crisis and generally improving business performance.

<sup>9</sup> Nancy V. Daniels, Cindy Dustin, "Empowering the next-generation workforce through AR innovation" May 25, 2022 <https://www.weforum.org/agenda/2022/05/ar-manufacturing-next-generation-workforce/>

<sup>10</sup> LinkedIn Learning, 2018 Workplace Learning Report: The Rise of Responsibility of Talent Development in the New Labor Market, [linkedin-learning-workplace-learning-report-2018.pdf](https://www.linkedin.com/learning/workplace-learning-report-2018)

<sup>11</sup> Eri Hariu, Leif-Olof Wallin, GARTNER, "Innovation Insight for Immersive Technologies in Frontline Working" 21 September 2021, <https://www.gartner.com/en/documents/4006012> pg5



## ARKEMA

Arkema aims to be a leader in Specialty Materials by offering its customers the most sustainable and innovative solutions to meet their needs.

### THE CHALLENGE

Ensuring quality is extremely critical to avoid exporting defects to customers. Failure to do so can result in exponential costs. However, controlling the conformity of industrial equipment is a highly complex and lengthy process.

### THE SOLUTION

Arkema turned to an Augmented Reality solution to inspect and control boiler-making equipment before they are sent to customers. It allowed them to:

- Guide operators through the points to be checked
- Ensure all aspects of the inspection were covered
- Compare the 3D model to its real world counterpart to ensure accuracy

## AR/VR AS A TRANSFORMATION FORCE MULTIPLIER

So, the question becomes, how does this all impact digital transformation? Profoundly is the answer as more and more companies are reorienting their transformation programs to prioritize addressing the Manufacturing Labor Crisis. The Crisis becomes the meta-priority with cascading demands, including:

- **Even more pressure on labor productivity to offset shortages**
- **Focus on “door-to-floor” metrics for training effectivity**
- **Improving worker satisfaction in their positions**
- **Increased pressure on quality to maximize product shipments**

One Transformation Leader summarized the impact reflecting a common outcome: “COVID changed everything. Our CEO said that labor issues must now be the primary focus of our digital transformation effort given its impact on our ability to serve our customers.”<sup>12</sup> The Manufacturing Labor Crisis may not be the only focus of Transformation Programs everywhere, but it has become a priority in most companies.

We have seen that AR/VR can directly and dramatically impact the Manufacturing Labor Crisis. In addition, the technology can positively impact several initiatives within your Transformation Program when deployed effectively.



## OPERATIONALIZES THE DIGITAL TWIN AND THREAD

Key to many companies’ transformation initiatives is the deployment of digital twin technology across the company. In its simplest form, a digital twin is a virtual (digital) representation of a physical object. For example, computer systems are now “twinning” aircraft with computers and simulating their performance across a variety of dimensions. The use of digital twins in this area is about improving the design before the costs of the prototype or actual build are incurred.

Increasingly companies are seeking to implement more comprehensive digital twins of the manufacturing plant or the product as manufactured. The comprehensive view of the digital twin has a virtual representation of a specific jet engine or manufacturing plant along with the manufacturing process. These more sophisticated digital twins are all about the manufacturing assets, manufacturing processes, and the product As-built, As-maintained, As-serviced, and As-used (increasingly including social media) history of the specific item.

AR/VR is, in many ways, the “last mile” in the comprehensive digital twin. 3D models created in R&D can be leveraged effectively in manufacturing, closing the gap between the virtual and real worlds. Rapidly illustrating proper assembly processes and quality instructions ensures everyone throughout the company utilizes the same digital information ensuring configuration and document control. The circle is closed as these models can also be used to provide direct, visual 3D feedback on actualities in manufacturing and/or in the field back to engineering. In traditional environments this valuable feedback is often not captured or put in the proper 3D model context, thus diminishing its value. It is virtually impossible to communicate the location of a scratch, dent, or defect in the standard text boxes commonly available in quality systems. Graphical defect data collection is more straightforward for frontline workers, more effective in communication, and critical to completing the digital twin.

<sup>12</sup> Chief Transformation Officer of a Fortune 500 manufacturer at LNS Research’s IX Event, October 20, 2021

# CONTRIBUTES TO A MYRIAD OF ADDITIONAL TRANSFORMATION GOALS

LNS Research has surveyed the market and found the following to be the global key focus areas of IX Programs. Industrials are building their business case for Industrial Transformation (IX) around improving quality, productivity, safety, NPI, etc. They are seeking step-change improvements across the value chain.



AR/VR directly contributes to all those key program drivers:



**Manufacturing quality improves through better knowledge capture, increased ramp-up skills, and measurement.**



**Productivity improves by making the least experienced operators execute at the same level as the most experienced operators (and by improving quality).**



**Safety increases as frontline workers have step-by-step instructions that guide them in proper execution.**



**NPI accelerates through the completion of a comprehensive digital twin. LNS found that Transformation Leaders were TWICE as likely to implement AR/VR as followers.<sup>13</sup>**

AR/VR also provides a multiplier effect when deployed as part of a larger transformation strategy. For example, deploying AR/VR with MES or MOM – a system to provide visibility into, control over, and synchronization across manufacturing – contributes to 3D immersive work instructions that can accelerate user acceptance of the MES system and provide a tangible first app quickly. MES extends the impact of AR/VR by making it a subsystem to a bigger, more comprehensive whole. AR/VR is a natural extension of 3D-based manufacturing engineering and industrial engineering, providing the visual representations needed to connect engineering with the shop floor. This reduces time, error, and operational latency between departments while converging the virtual models with real-world operations.

<sup>13</sup> Tom Comstock, LNS Research, "Understanding Digital Transformation Today: Digital Readiness is the Foundation for Success" 2019 <https://members.lnsresearch.com/research-library/research-articles/IX-digital-readiness> pg. 24

## CONCLUSION

Most likely, your company feels the Manufacturing Labor Crisis - even if it does not call it by that name - and you are planning a Transformation Program. AR/VR technologies positively address the challenges of knowledge capture, training, retention, and labor productivity.

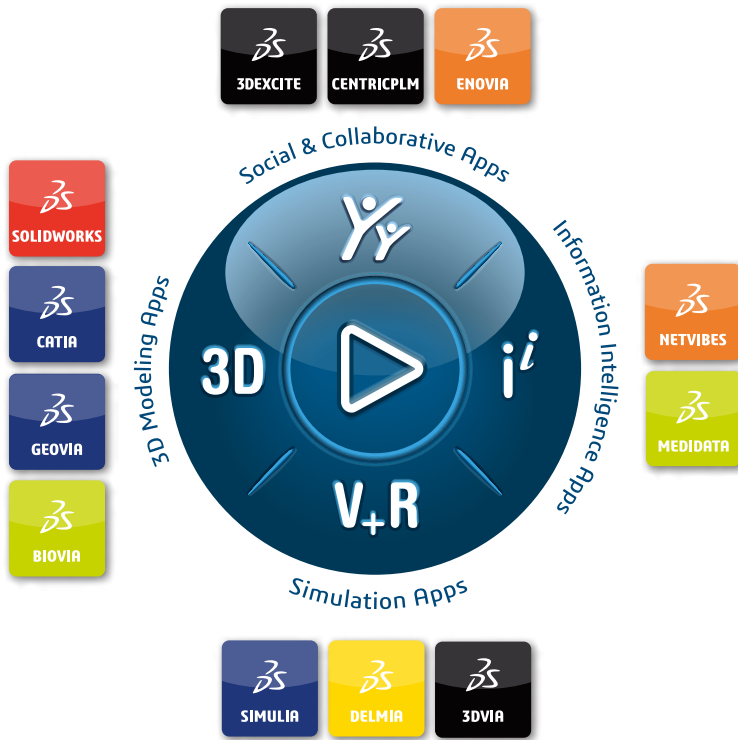
Implementing AR/VR as part of your digital transformation program will:

- ✓ **Reduce workforce attrition and “tribal knowledge” from walking out the door**
- ✓ **Increase skill ramp-up for new hires**
- ✓ **Capture crucial and inherent knowledge critical to successful business operations**
- ✓ **Become an employer of choice by offering innovative technologies for training and workforce safety**
- ✓ **Ensure productivity, quality, and satisfaction with accurate assembly work instructions**

Finally, AR/VR is a multiplier as it contributes to the multitude of goals that Transformation Programs pursue. AR/VR operationalizes digital twin strategies, improves quality and manufacturing productivity, and accelerates new product introduction while providing immersive and intuitive technology to provide feedback and close the digital twin loop.

Contact your Dassault Systèmes representative today to discover how AR/VR can contribute to your organization.





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