

Hydraulic System

HS31

Emergency Transfer

Hydraulic System

HS31

Hydraulic Pressure

Hydraulic System

MA913

Main Actuators

DISCOVER how aerospace and defense leaders are using AR to empower their workforce with improved skills and efficiency, ensure safety and compliance, and drive digital transformation.

SUPERCHARGING Aerospace and Defense with Augmented Reality

AR is Transforming Industrial Markets



Industrial companies are projected to invest over \$7 billion in augmented reality by 2024, but many are already driving measurable ROI for service, training, sales and marketing, and manufacturing use cases.

Augmented reality is a game-changer for industrial enterprises because it focuses on generating business value through worker effectiveness.

Companies using AR to empower their workforce are already seeing increased productivity, reduced waste, and improved safety and compliance.

The future of factory floor and field service workforce communication will increasingly rely on augmented reality as an efficient, flexible workforce multiplier. Vast numbers of technically skilled workers are aging out of the workforce, taking irreplaceable domain expertise with them. Correspondingly, the new generation's incoming workforce, third-party contractors, and redeployed workers lack experience and need to be trained quickly and efficiently.

Companies can no longer expect traditional hard copy instructions and basic training methods to be sufficient to develop a high-efficiency workforce. Nor can they rely on lengthy apprenticeships to combat increasing complexity and variation amongst products and production lines.

To address this new labor dynamic, industrial manufactures must implement modern training and workflow documentation strategies.

Defining Industrial Augmented Reality

Augmented reality is the overlay of digital content over specific physical targets of interest. While experiences can vary substantially, most instances of industrial AR include the following components:



1
A physical reference point. Targets can be generic (e.g. a horizontal plane), or a highly-specific point—recognizable by its unique form, or an individual reference tag (e.g. QR code).



2
Corresponding digital content that is displayed to the user, once a target is recognized. Information can include instructions, real-time status information, or supplemental content that enhances the user experience.



3
Authoring software that merges digital content and physical targets. These vary from developer-intensive platforms, to no-code, out-of-the-box solutions.



4
User software that recognizes a physical target, and overlays corresponding digital content. Authoring and user software are typically part of the same solution.



5
User hardware for experiencing AR content. This can include a smartphone or tablet, or purpose-built digital eyewear that enables a hands-free experience.

Effective Industrial AR Applications

Industrial augmented reality applications can drive value across the enterprise value chain and throughout a product's lifecycle.

Analyst research indicates that industrial AR applications offer easy deployment and a rapid ROI when deployed for specific solutions, particularly for manufacturing, service, and marketing and sales use cases.

Augmented 3D WORK INSTRUCTIONS

Product complexity and the workforce skills gap increase the potential for human error and an unsafe work environment. Immersive AR experiences push back against these challenges with in-context, step-by-step instructions that boost safety, agility, and productivity for front-line workers.

- AR enables workers to visualize hidden components and complex data.
- AR can decrease inspection time and improve quality.
- AR can help reduce error-rates in assembly.
- AR can improve cycle-time and first-time fix-rates for maintenance and repair.

Augmented TRAINING AND DEMONSTRATION

As the FA&D skills gap continues to widen, traditional training methods will not be sufficient to bring new workers up to speed quickly and effectively. AR accelerates the process of turning new hires into competent, effective workers.

- AR improves knowledge retention and ensures better-quality training.
- Training curriculum can simulate conditions that would be unsafe or impractical for trainees.

- Materials can be rapidly customized for upgraded content and user localization.

Augmented EXPERT GUIDANCE

Seasoned career experts are likely the most valuable human capital resource in your organization. Unsurprisingly, they are usually in short supply and their expertise is expensive to utilize. AR can extend the reach and value of these experts in exciting ways.

A class of AR solutions, like PTC's Vuforia Expert Capture, facilitate the first-person recording of experts at work, allowing them to turn their expertise into a consumable, reusable knowledge asset—capable of training and guiding newer workers. Knowledge can be easily captured and scaled across the enterprise.

- New workers become competent faster by learning on-the-job.
- Standard Operating Procedures can be documented on-the-fly without disrupting high-value workers.

Remote assistance solutions enable experts to collaboratively solve problems by virtually connecting with less-seasoned colleagues through AR-enhanced video-sharing technology.

As products grow more complex and competition requires the FA&D industry to become more agile, these solutions help extract more value from your experts, without overtaxing individuals.

- Senior experts can virtually assist less experienced on-site techs, enabling a hybrid service approach that ensures positive outcomes while conserving resources.
- Remote assistance accelerates responses by allowing the closest technician to function competently as a "first responder" with AR-delivered backup.

Product & Solution VISUALIZATION

Product visualization is a cornerstone of AR. The ability to present a full-scale digital representation of physical products can solve several challenges.

- Full-scale virtual demos of expensive and unwieldy equipment can be provisioned for real-world environments.
- Interactive previews can reflect near-limitless customization.
- Products can be quickly reconfigured on-the-fly to meet specific customer requirements, without the need for time-consuming retooling.

Optimizing Efficiency, Safety & Compliance: AR for Aerospace and Defense Manufacturing



FA&D is a highly competitive, complex, and regulated industry.

And while companies compete to provide increasingly complex and customized products, the aging workforce is proving difficult to replenish. Industrial AR is an invaluable new solution for FA&D workforces: offering efficiency, agility, compliance and safety gains—while reducing costs.

AR applications offer a continuum of support for manufacturing workers across all experience levels. AR-based onboarding and training can accelerate ramping-up new workers, while improving their retention and competency. AR-enhanced guidance and work instruction can assist newer and seasoned workers—with immersive guidance for even the most specific and customized tasks. In the event that unforeseen challenges arise, remote assistance and collaboration can enable tenured workers to assist their less experienced colleagues—regardless of their physical proximity.

AR's impact on manufacturing:

- Decreased equipment downtime
- Reduced cost of defects, rework and scrap
- Optimized machine set-up, changeover, and maintenance processes
- Reduced assembly and operator errors
- Streamlined inspections
- Improved compliance processes
- Increased worker safety
- Reduced time and cost of onboarding

Improving Quality and Profitability: AR for Aerospace and Defense Service



As competition escalates in aerospace and defense, a service-led focus on customer satisfaction and new revenue streams is helping companies differentiate and drive growth. True service-led transformation can be a challenging strategy to execute and places a premium on experience. Skilled career experts are aging out of service markets. Conversely, underskilled workers can have a detrimental effect on service outcomes and customer satisfaction. Industrial augmented reality is proving to be instrumental in improving technician proficiency—and in ensuring service efforts are successful.

Similar to manufacturing use cases, AR supports service workers throughout their skills development process. AR-based onboarding and training can speed ramp-up time for new or redeployed service techs, while ensuring that once in the field, they are equipped to handle the task at hand. AR-enhanced guidance and work instruction helps ensure that service visits have faster, more successful resolutions. Easy access to live remote assistance is invaluable for rapid trouble-shooting of complex or unexpected problems, allowing companies to use their valued experts more effectively—by providing real-time remote assistance to more junior technicians.

AR's impact on service:

- Improved overall service quality and profitability
- Increased first-time fix rates
- Reduced travel costs
- Decreased mean time to repair
- Improved uptime and meet SLAs
- On-demand problem solving
- Increased worker safety
- Superior customer satisfaction scores

Enhancing Learning Outcomes: AR for Aerospace and Defense Training



The lack of an able workforce in FA&D has intensified the need for companies to quickly onboard and upskill new or seasonal workers.

There's an urgent need to transfer the skills and knowledge of experts to the new generation of workers, but poor training methodology and complexities across assets, workflows, and facilities make ramping up new workers challenging.

AR delivers tremendous value for training use cases with visual, highly-

engaging training experiences that have been proven to improve comprehension, retention, safety and time to worker productivity with fewer errors. AR allows for real-time, on-the-job training and upskilling for new or unfamiliar tasks. Interactive in-context 3D instructions and expert guided procedures provide industrial workforces with critical domain knowledge.

AR's impact on training:

- Faster ramp-up time for new or seasonal workers
- Reduced training and adoption times for new skills
- Improved safety and compliance
- Lower overall training costs
- More flexible, agile workforce
- Increased job satisfaction
- More effective recruitment of "digital natives"

Differentiating Product Demonstrations: AR for FA&D Sales and Marketing



With fierce competition in the FA&D market, the ability to differentiate products and the buying experience can pay serious dividends. Expectations are shifting—today’s customers are no longer satisfied by physical product brochures, cumbersome demonstrations, and painfully slow sales cycles. Industrial AR enables manufacturers to stay several steps ahead of the competition, while also reducing avoidable sales and marketing costs.

As full-scale digital renditions of physical parts and equipment, AR-based product demonstrations make unique features

and product innovations easier to visualize and understand. AR-driven demonstrations cost less because they can be culled from anywhere—including at trade shows, in factories, or in meeting rooms—without any shipping or transportation required. Creative uses of AR can also provide manufacturers with enticing interactive experiences that delight brand enthusiasts.

AR’s impact on sales and marketing:

- Increased revenue and year-over-year business growth
- Faster sales cycles with fewer reconfigurations
- Less need for printed collateral and physical materials
- Reduced shipping costs
- Stronger brand reputation

Supercharging Existing Assets with AR

Whether applied to engineering and manufacturing processes, or the aftermarket service side of the business, today's AR solutions can elevate the effectiveness and value of existing assets by supercharging them with AR.

Traditional instruction manuals	In-context 3D instructions
<p>Printed instruction manuals are the cornerstone of traditional operational and service guidance, but they are no longer the most effective way to put critical information at the fingertips of frontline workers.</p>	<ul style="list-style-type: none"> • Cost-effective and fast to develop • Content is immediately available to frontline workers when published • Step-by-step instructions delivered in the context of physical assets or environments are easier to interpret • Animation and iconography reduce translation needs • Easy to maintain and can be updated on-the-fly • Digital eyewear allows technicians to access hands-free instructions for improved safety and efficiency
CAD and digital design assets	Full-scale product visualization
<p>CAD and other design assets are a key part of the product design process. However, these assets typically go unused once the design process is complete.</p>	<ul style="list-style-type: none"> • Product designs can be experienced in a physical setting • Immersive and visually engaging • Minimally dependent on location • Easy to transport across geographies and languages • Can be paired with step-by-step instructions for more effective training • Can be repurposed for static or animated schematic overlays
Industrial IoT Data	Performance and status data overlaid onto the physical world
<p>IoT data is already proving to be useful in the form of customizable views of factory and plant performance. These same platforms can be used to collect and present real-time status and performance data to front-line operators and service technicians.</p>	<ul style="list-style-type: none"> • Allows a user to “see inside” equipment without having to physically open enclosures • Helps visually identify assets in need of maintenance or service—from a distance • Unlocks additional worker efficiencies • Saves time and prevents human error • Provides additional safety in the event equipment is unstable or unsafe to operate

PUTTING IT ALL TOGETHER:

Driving Digital Transformation with AR



When correctly implemented, industrial AR can have a transformative effect for FA&D companies. Specifically, AR has proven to improve processes and outcomes through a more effective, technical workforce. Digital transformation initiatives that include industrial AR can lead to increases in productivity, reduced waste, and safety and compliance improvements. Leading FA&D companies are turning AR investments into real-world gains. With adoption easier than ever, the time to get started is now.

LEARN MORE about **Vuforia**, PTC's portfolio of industrial AR products

Even within aerospace and defense, AR is far from a one size fits all solution.

The unique structure, challenges, and opportunities of your organization require that you pursue specific AR applications that will provide rapid, meaningful business value.

To that end, PTC is continually innovating with a robust portfolio of industrial AR applications, each with unique attributes to help you safely and quickly navigate from pilot to production.

Vuforia Expert Capture is an out-of-the-box solution designed to improve workforce productivity, quality, and safety and compliance by empowering frontline workers with the relevant expertise to get the job done quickly and accurately the first time. [Learn more about Vuforia Expert Capture.](#)

Vuforia Studio accelerates 3D content creation of scalable, immersive AR experiences that improve service, manufacturing and training processes by empowering front-line workers with contextual knowledge. [Learn more about Vuforia Studio.](#)

Vuforia Chalk makes it easy for anyone in the enterprise to collaborate, by drawing over live video with their finger to precisely indicate critical instructions via remote guidance. [Learn more about Vuforia Chalk.](#)

Vuforia Engine provides robust, cross-platform software that enables branded AR experiences for both new and existing apps through popular development platforms. [Learn more about Vuforia Engine.](#)

As the leader in industrial AR, PTC has a proven track record partnering with aerospace and defense companies to build AR success.

FOR MORE INFORMATION
about how you can experience
AR-driven digital transformation,
contact an AR specialist at
PTC today.

[CONTACT an AR Specialist](#)