



Industrial Augmented Reality **BUYER'S GUIDE**

► Select the Right AR Solutions for Your Business




Building a Successful Industrial AR Strategy

Industrial businesses are investing heavily in augmented reality (AR), and successful adoption is proving its value. AR—**the ability to digitally overlay physical objects and environments with contextual information**—offers a broad range of potential applications. Because AR's capabilities are so open-ended, project success requires focusing on those applications that will return the most value. You can begin identifying high-value applications by answering these questions:

- Which **business areas will immediately benefit** from AR capabilities?
- Which **AR projects are most relevant** to these business areas?
- Which **AR functions and capabilities** are needed to implement these projects?
- How do you leverage this information to **make the right AR investments**?

AR success depends on investing in projects that are right for *your* business; we've produced this buyer's guide to help direct your AR planning process.



Getting Started with AR

Every organization that can benefit from AR has unique challenges and opportunities. Some companies may be facing an imminent shortage of new skilled workers; others may service extremely complicated and customized equipment; others still may collaborate across continents to propel sales activities forward. To better recognize and prioritize your challenges and AR opportunities, we offer an eBook collection of [expert recommendations from across the AR industry](#). For more in-depth guidance, "[Getting Started with Industrial AR Solutions](#)" provides actionable guidance for AR pilot projects.

How Augmented Reality is Changing Industrial Markets

Numerous markets are embracing augmented reality, with a projected investment of over \$7 billion by 2024, in U.S. markets alone. Industrial businesses are looking to be making the biggest AR moves.¹ While it represents a substantial indicator of interest, it's hardly surprising, given AR's proven ability to rapidly exceed returns on investment.

Industrial AR business drivers

Industrial augmented reality applications can drive value across an enterprise value chain and through a product's lifecycle. Analyst research indicates that industrial [AR applications enjoy easy deployment and a rapid ROI](#) when they are targeted around specific business functions. A majority of survey respondents indicated that AR is driving ROI in the following areas:

76%
Manufacturing



Includes the set-up, assembly, operation, and maintenance of equipment. [Learn more here.](#)

62%
Service



Includes preventative service and repairing faulty equipment. [Learn more here.](#)

65%
Sales



Can span the entire buying process from early marketing engagement through to post-sales, customer success. [Learn more here.](#)

51%
Training



Covers the onboarding and initial skills development of workers across business functions.

1. <https://www.gminsights.com/industry-analysis/augmented-reality-ar-market>

PTC Vuforia: Unsurpassed AR Solutions

PTC's Vuforia portfolio of AR solutions delivers rapid value and addresses a broad range of workforce challenges facing industrial companies. To assist your evaluation, the following section details each product's **core features, capabilities, and optimal use-cases**. Offering best-in-class computer vision, robust tracking capabilities and broad platform support, PTC's Vuforia portfolio is recognized as the market leader in industrial AR software solutions. Vuforia technology is used by over 600,000 registered developers and hundreds of enterprise customers, spanning dozens of industries.

Vuforia augmented reality portfolio

Vuforia AR solutions enable industrial enterprises to create and deliver easily-consumable instructions with new or existing media content/capture, 2D & 3D content, sequences, IoT data and real-time annotations in shared environments.

Our cross-platform approach enables users to view AR experiences on industry-leading mobile devices and 2D & 3D eyewear—including out-of-the box support for Microsoft HoloLens and HoloLens 2, Realwear, and Vuzix.

Vuforia's portfolio consists of four AR solutions, each optimized for specific capabilities and use cases. To assist your evaluation, the following section details each product's **core features, capabilities, and optimal use-cases**.

Vuforia Studio

Efficiently author scalable AR experiences– without skilled programmers or costly custom designers

Using Vuforia Studio, practitioners and subject matter experts, can author and publish easily-consumable AR experiences. With a robust, visual interface, easy design file importing, and ubiquitous viewer support, Vuforia Studio accelerates time-to-value.

Distinguishing features and capabilities:

- Visual authoring environment
- Easily import CAD and animated sequences
- Scales to support global AR deployments
- Native support for IoT data
- Certified support for hosting and on-premise deployments
- Powerful spatial and model tracking
- Out-of-the-box support for a mobile and headworn devices, including Microsoft HoloLens and HoloLens 2

Best for:

- 3D digital content overlaid on real-world equipment to provide contextual knowledge
- Rapid development of immersive training and instruction content.
- Reusing existing CAD models & sequences to create step-by-step work instructions.
- Visualizing real-time IoT data to provide operating conditions and equipment performance.
- Full-scale visualizations that enable walking around and seeing inside products.
- Accurate identification of spare parts
- Scaling across products, configurations, devices and geographies.

How to evaluate:



Contact a Vuforia
AR Specialist

Vuforia Engine

Develop fully branded, cross-platform AR experiences with unmatched flexibility and target recognition, for new and existing apps

With Vuforia Engine, AR developers can harness best-in-class computer vision capabilities, to detect and launch experiences from a variety of target types. With broad support for leading modelling platforms and user apps, Vuforia Engine enables richly branded AR apps.

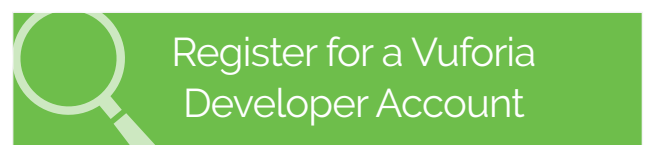
Distinguishing features and capabilities:

- Robust computer vision allows experiences from the widest range of target types—including objects, models, images, surfaces, multi-targets, cylinders and VuMarks.
- Cross-platform development supports Android AR Core and iOS ARKit.
- Vuforia Fusion enables easy optimization of AR experiences across a range of devices.
- Seamless integration with industry-leading complementary design and modelling applications.
- Broad community of developers and agencies with deep Vuforia Engine experience.

Best for:

- High-end production of white-labeled and custom AR applications.
- Developing consumer-facing applications that require superior production values.
- Integration with industry-leading design and modelling application.
- Experiences that require sophisticated and flexible target recognition.
- Elevating brands with complementary apps
- Direct consumer revenue models

How to evaluate:





Vuforia Chalk

Easy-to-deploy, easy to use mobile-based guidance and collaboration

Vuforia Chalk enables pairs of mobile device users to collaborate around a shared view of objects and environments, with smart 3D annotation capabilities. Chalk allows senior experts to virtually share knowledge with junior colleagues and removes geographical barriers to collaboration.

Distinguishing features and capabilities:

- Zero development requirements; Vuforia Chalk can be provisioned in minutes and used immediately by licensed mobile device users.
- Via mobile devices, pairs of chalk users connect with a video link, to share a view of equipment or an environment. Each user can draw on their screens to annotate that shared view.
- Advanced computer vision intelligently locks annotations onto targets, so that users can move around objects and annotations with 3D spatial recognition.
- Chalk views can be paused, allowing users to more easily draw multi-step instructions over objects.

Best for:

- Enabling remote, virtual assistance between technicians and experts.
- Collaboration between physically dispersed colleagues and teams.
- Building lightweight AR pilots that prove value fast without development resources.

How to evaluate:



Contact a Vuforia
AR Specialist



Vuforia Expert Capture

Transform knowledge into hands-on guidance and skills development

Vuforia Expert Capture is the fastest, easiest way to create powerful step-by-step instructions that help front-line workers get their jobs done quickly and accurately. This out-of-the-box solution features drag-and-drop AR content creation for industrial enterprises looking to rapidly document expert knowledge and then easily scale that knowledge to new or redeployed workers as hands-on training or task guidance.

Distinguishing features and capabilities:

- Rapidly author AR instructions without CAD data, pre-existing assets, or development efforts.
- Easy-to-use templates that simplify and accelerate creating and publishing content.
- Editing and publishing content is simplified in a secure, web-based environment.
- Workers benefit from easily-consumable, on-the-job guidance.
- Deliver automatically optimized content across a variety of supported devices.

Best for:

- Capturing procedures and tasks from the perspective of senior experts.
- Servicing and working with factory floor machines that lack relevant CAD data, or documentation is unavailable or of poor quality.
- Documenting multi-step procedures that take place in multiple locations within a space.
- Ensuring compliance through documentation of standard operating procedures (SOPs).

How to evaluate:



Contact a Vuforia
AR specialist

Results-Driven AR Evaluation Criteria

When considering AR solutions for investment, there are multiple criteria to evaluate. Because each company has unique challenges and opportunities, this step is critical—both to validating initial projects and ensuring that budgets are being spent on the right hardware and software.

Augmented reality use cases

Depending on how any given company runs these business areas, they are likely to find value by using combinations of the following AR application use cases:

Onboarding and on-going skills training

AR delivers value to training use cases with the ability to build immersive training experiences. Training applications may provide a fully digital training simulation or combine physical equipment with digital curriculum overlays.

Step-by-step instruction and guidance

AR can assist workers of all experience levels via 3D step-by-step instructions or expert led procedural guidance. These applications use contextualized digital overlays or expert video capture to either assist less experienced workers, or to guide workers during new or extremely complex tasks. AR-guided experiences can also reorient workers of all experience levels on best practices, and ensure that jobs are completed correctly the first time.

Remote assistance and collaboration

AR can bring together physically separate workers—via collaborative apps that combines live video, audio and annotations of the live shared view. Experts can advise less experienced workers, helping them resolve unfamiliar or unexpected issues. Remote collaboration can help workers team up, whether they are in different plants—or continents.

Product visualization and demonstration

Beyond visualization for training purposes, AR offers tremendous potential to demonstrate, customize, configure, and experience digital previews of physical products. This facilitates activities, such as sales and marketing, where costs can be driven sharply by product size, complexity, cost, or customization potential.

Branded product and customer experience

Industrial markets are increasingly catching up to the commercial utilization of applications that heighten the experience for owners. Combining attributes of the previous use cases, brand experiences ensure more successful and satisfied owners.

AR audiences

The intended user audience can be a key factor in selecting both software and hardware.

Internal users

For internal use applications, such as new user training and service and manufacturing procedures, prioritize software that emphasizes agility, rapid development and iteration, and IoT integration. Don't assume these require development-intense resource requirements. Select hardware investments based on their ability to meet needs like hands-free guidance, ergonomics, and software compatibility.

External users

For applications with external users, brand experience may dictate selecting AR solutions that place a premium on presentation and production—even at the expense of rapid development. Conversely, external users—particularly in consumer markets—essentially dictate hardware decisions; there will be little ability to persuade this audience to invest in specific brands or types of AR hardware. In these examples, you should base solution choices on mobile device compatibility.

Development expertise

AR authoring applications typically balance depth of features against ease of use. Some solutions emphasize visual authoring environments that non-developers, including practitioners and subject matter experts, can use to efficiently create AR/MR content. Others provide an array of API and SDK options that require skilled development resources. Make this consideration carefully; it's easy to assume that solutions with the deepest range of potential capabilities are the best, but this isn't necessarily the case. If an AR project is practical in application, leans heavily on subject matter experts, or is part of a pilot with limited resources, consider a solution that is not dependent on developer skillsets. The challenge in many pilot situations is that your development resources are likely already fixed; adding headcount or finding the right AR development contractor may be out-of-budget, out-of-scope, and frankly unnecessary, depending on the pilot's objectives, and the software being used.

Robust Development Expertise

If your organization has the resources to allocate skilled AR development experts, you can consider solutions that are more open-ended, making use of code-rich SDKs. These projects also run the risk of scope-creep, so it will require a project manager who can keep developers focused on task. It's important to look at some of the other evaluation criteria even if these resources are available, as these resource-intensive projects can chip away at potential ROI arguments as you make the case for putting AR into production.

Minimal/Reduced Development Expertise

If your organization has no purely dedicated AR developers, or limited to savvy non-developers, you should absolutely consider solutions that require minimal expertise. These applications emphasize efficient visual authoring environments. They strike a balance between lower flexibility and customization options, versus ease-of-use. With the right solution, you can create robust solutions without developer involvement, with the potential of adding more value later. You may find that some adjacent technical expertise, such as someone in your engineering department with CAD skills, can complement your project—even if they have no AR experience.

No Available Developer Expertise

For many organizations, any developer expertise may simply be out of the question—particularly for a pilot. In these situations, you should look for tools that are truly out-of-the-box. This may require some project strategy creativity; if the pilot goal is to increase field service efficiency, you may find that projects with zero development requirements will meet your immediate needs. Highly effective AR solutions are available with developer requirements, such as AR remote-assistance application, and/or video expert knowledge capture solution applications. A smart strategy in these situations is to plan a "no-code" pilot, to prove value, while identifying a low-code solution for subsequent projects. But you'll likely find that even no-code options can provide significant value for your business.

Development frequency and content customization

Some AR projects—like an app promoting a product release or media event—are intended to exist with a limited shelf-life and a specific audience. Other projects, such as AR-based training and guidance, should be viewed as a long-term investment, requiring the ability to maintain, manage, and scale content over time. Understand and prioritize your scalability and customization needs when selecting an AR solution. In manufacturing and service, AR content customization is driven by two main pressures: products and users.

Product-driven customization

Content customization is driven by customization of the products and processes being documented by AR. If AR work instructions need to be created, updated, and customized for multiple-products or configurations, you should be certain your AR solution provides the required scalability.

User-driven customization

Content customization can also be pushed by the audience using your AR experiences. The dynamic, global nature of your operations should be considered. Whether your manufacturing operations change or expand geography, or your service organization enjoys rapid growth into new territories, these can impact the need to rapidly update and localize AR content.

Regardless of where the pressure is coming from, if you expect to regularly update and publish new content and variations to content, ease of scalability should be a key requirement in AR selection.

Branding

Project owners should also consider if branding is required. If the experience is being used by customers and partners or being used for sales and marketing purposes. Externally facing experiences often warrant being presented via branded AR application. Conversely, if internal users are the target consumers, the more simplistic authoring tool may be a better path forward.

Available digital assets

AR is as much about content as it is the experience of consuming it. Consider creating an inventory of relevant content that could be leveraged to enhance your AR experiences. This content availability can shape your specific AR experiences, and the solutions you select to build them.

- For some use cases AR content can be created without pre-existing assets simply by recording the best-practices of SMEs while they are performing specific procedures.
- More complex procedures may require the creation of immersive, 3D work instructions and full-scale product visualizations for training. These types of AR experiences require CAD models and may incorporate instructional iconography or text, animation sequences, and IoT data.

Depending on project needs, you should identify all of the potential digital asset requirements, including what platforms are required to create, edit, and manage them. The right AR authoring solution will need to support seamlessly importing and using these digital assets.

IoT integration support

AR can assist users in the assembly, operation and servicing of specific models of equipment. But with IoT integration, AR's value is significantly greater. That value is provided through revealing equipment status and performance data, and overlaying in the context of the physical equipment. Particularly for maintenance and service, real-time IoT data can be combined with AR guidance to enable new levels of safety efficiency.

Your evaluation should begin by identifying if IoT solutions are already in use, the platform being used, and which assets and equipment are connected. If you are using an industrial IoT solution that simplifies integration, such as PTC's ThingWorx, you should be able to fairly easily leverage relevant equipment data as needed for AR experiences. If your organization isn't currently implementing an IoT strategy, or using a custom or homegrown software, AR/IoT integration may prove too complex, and warrant deferring it to a later time.

Tracking Methods or Technology

Some AR experiences are triggered by marker-based tracking such as simple QR codes, while others use sophisticated computer vision technologies that enable more advanced model-based, image-based, scanned-object and spatial tracking. The choice of using one type of tracking method over another will be driven by your use case (e.g. an assembly line with hundreds of identical physical devices may not be an ideal setting for shape-based recognition). You may even require a solution that allows for multiple types of targeting, depending on your various use cases.

Hardware experience

Hardware choices are often determined by a project's primary user type. For internal use, such as training, the type of hardware is mandated by the organization. For external use, such as branded customer and promotional experiences, the user dictates the device of choice. For that reason, supporting a variety of options is critical to engagement. Weigh the value of wearables (i.e. hands-free interaction) against the cost and availability of such hardware, versus ubiquitous mobile devices.

Platform and operating system support

Similar to hardware choices, platform choices are often dictated by your user base. If a hardware choice has been pre-selected, it may dictate which operating system to use. Some enterprises are standardized on a single platform, such as Android or iOS, while others will see value in a more flexible environment. Externally-facing experiences typically have the least control over user operating systems, and should prioritize supporting the widest range of platform support. Deciding which platforms to support and whether the apps' underlying technology needs to "bridge" platforms is an important consideration.

Hosting

Hosting considerations can be overlooked, but for some industries and geographies, cloud is not an option. For some organizations, on-premise is a requirement, based on security, compliance, connectivity, and other considerations. For other organizations, the cost and agility benefits of the cloud are preferential. It is important to understand what the hosting requirements are for a fully deployed production solution, particularly if pilot requirements are more flexible.

AR Success Starts with Smart Projects—and the Right Tools

It's no surprise that Augmented Reality is gaining traction and getting results in industrial settings. AR is easy to deploy relative to many other technologies. AR authoring practices are flexible, whether you favor rapid development for practical internal use, or development-heavy solutions designed to elevate the experiences of purchasing and owning products. And AR provides valuable solutions to a previously underserved operational asset—your skilled workforce.

Despite all AR's advantages, success isn't preordained. You need to focus on projects and use cases that add real value. You need to identify the capabilities needed to deliver those projects. And you must evaluate your AR technology options based on those capabilities.

The following section serves as a quick reference to understand and compare technical functionality against your business criteria, so that you can make the best AR investment decisions for your particular business needs.

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Vuforia Solution Checklist

To better prioritize, plan, and invest in the right technology, the following table clearly defines which Vuforia AR technology solutions are relevant for different operations, challenges, and opportunities. Carefully understanding your challenges and the right solution will help optimize your chances of turning a Vuforia trial evaluation into a successful AR pilot project.

- = Fully Supported
- = Supported

		Vuforia Studio	Vuforia Engine	Vuforia Chalk	Vuforia Expert Capture
Use Case	Step-by-Step Work Instructions	●	○		●
	Remote Assistance & Collaboration			●	
	Onboarding & Training	●	●	○	●
	Product Demos & Visualization	●	●		
	Branded Product & Customer Experiences	○	●		
Users	Internal/Employees	●	●	●	●
	External/Customers & Partners	○	●		
Development Expertise	Minimal (Low-Code Templates)	●			
	High (Custom Experiences)	○	●		
	None (Out-of-the-Box Functionality)			●	●
Development Frequency	Frequent App Updates (Continuous Development)	●	○		●
Viewing Applications	Custom Branded App		●		
	Secure Enterprise Viewer App	●		●	

● = Fully Supported
○ = Supported

		Vuforia Studio	Vuforia Engine	Vuforia Chalk	Vuforia Expert Capture
No Pre-Existing Assets				●	●
Pre-Existing Assets	3D CAD Assets	●	○		
	3D Animated sequences	●	○		
	Videos and photos	○	○		●
	2D PDFs and Digital Documents	○	○		●
IoT data integration (ThingWorx)		●	○		
3rd party development tools			●		
Targets and Tracking Technologies	Model Targets	●	●		
	Image Targets	●	●		
	Multi Targets		●		
	Cylinder Targets		●		
	Object Targets		●		
	Marker-based Tracking	●	●		
	Automated Environment Learning			●	
Hardware	Phone	●	●	●	●
	Tablet	●	●	●	●
	Digital Eyewear	●	●		●
Platform & OS Support	Android	●	●	●	●
	iOS	●	●	●	●
	ARCore	●	●	●	
	ARKit	●	●	●	
	Windows	●	●		
Hosting	Cloud	●	●	●	●
	On-Premise	●	●		