

# Give Maintainer's 'Super Powers' with Augmented Reality

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GLOBAL PRODUCT DATA  
INTEROPERABILITY  
**S U M M I T**  
**2019**





**Principal Applications Engineer, PTC**

**20 years FA&D Experience**

**PLM / SLM (S1000D)**

**5 years Augmented Reality /**

**IOT Experience**

**MS ME / AI**

**Based in Pacific Northwest**

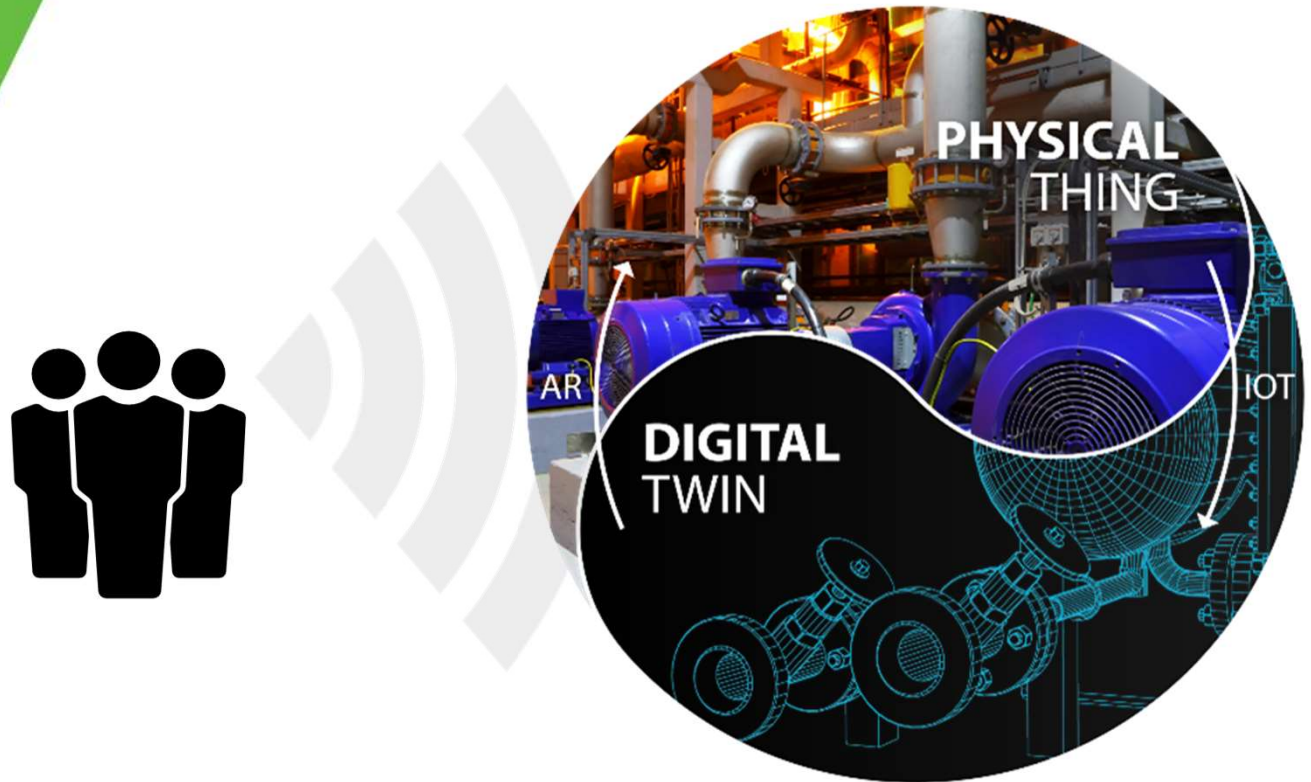
**Enjoy travel and hiking**



# PTC Strategy - Physical Digital Convergence

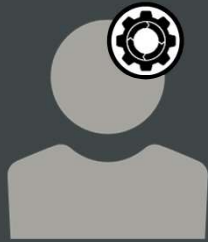
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Augmented Reality  
unlocks the value  
created by the  
**CONVERGENCE**  
of the **PHYSICAL,**  
**DIGITAL** and  
**HUMAN**  
worlds



# Increasing Pressures in Industrial Markets

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## Worker Skill Gap

31% turnover rate<sup>1</sup>

10 million jobs unfilled<sup>2</sup>

Ongoing skills upgrading



## Complex Products & Workspaces

Service/maintenance challenge, configurations

Information access & content creation



## Increased Customer Demands

Expectations of immediacy

Fiercely competitive & shifting marketplace



# Navy Business Plan Example

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***Lengthy training pipelines and increasingly complex machines, coupled with a young, rapid turnover workforce requires a new approach to learning, maintenance activities and manufacturing operations.***

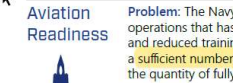


## 1.1 Restore Military Readiness to Build a More Lethal Force


### Why This Matters

Our armed forces have been involved in the longest continuous stretch of conflict in our Nation's history. The continuous nature of these engagements truncated essential maintenance and training, leading to deficiencies in safety, reliability, and availability of Fleet and Marine assets. Concurrently, these operations led to the depletion of weapons and ammunition stocks, as well as degradations to their supporting systems. Investment uncertainty resulting from budget control actions further complicated our efforts to maintain readiness and stable ordnance inventories, creating an erosion of capability across the force. The DON will make targeted, disciplined increases in personnel, platforms, weapons, ammunition, training, and maintenance to ensure that a larger, more lethal naval force is prepared to conduct combat operations against peer adversaries in any high-intensity conflict around the world.

➤ **1.1.A » Fully restore aviation/ship/personnel readiness to meet missions**



### Aviation Readiness




**Problem:** The Navy and U.S. Marine Corps (Marine Corps) aviation assets have experienced years of high-tempo operations that has increased the number of non-mission capable aircraft. The result—restricted flying hours and reduced training—led to decreased readiness rates and reduced operational effectiveness. Depots also lack a sufficient number of skilled workers and available aviation spares, both of which must be addressed to increase the quantity of fully mission capable aircrafts.

**Solution:** The Navy and Marine Corps aviation enterprise will focus on reducing the quantity of non-mission capable aircraft through focused maintenance and supply chain management, and expand training to develop a broader base of highly trained maintenance personnel.

- Produce a Navy P2P instruction for Aviation, Surface, Undersea, Safety, and Information Warfare
- Implement Marine Corps aviation readiness programs
- Develop and implement pilot program to reduce Long Term Down aircraft trends
- Identify material requirements to increase aviation readiness levels
- Ensure implementation of supply chain improvements to increase material availability and reduce backorders
- Implement a plan to develop artisan-level depot workers and to manage depot workflow

### Personnel Readiness



**Problem:** Readiness begins with Sailors and Marines who are deployable and well-trained. In the past, Navy and Marine Corps manpower policies, processes, and technologies have incrementally evolved to meet the demands of a force continuously engaged in conflict. Although these changes have resulted in many discrete improvements, the collective effect has not necessarily resulted in enterprise-level improvements resulting in increased personnel readiness. Given the rapid rate of change in the technological and warfighting domains alike, the DON's training must reflect greater agility and responsiveness to deliver warfighting effects when called upon. In addition, even when Sailors and Marines are successfully trained, the DON continues to experience non-combat related injuries, fatalities, and mishaps that undermine the DON's ability to execute mission-critical tasking.

**Solution:** The DON will use the Navy's Ready-Relevant-Learning effort and the Marine Corps' Manpower Modernization Goals to fundamentally transform its training model and identify modern training solutions, delivered at the point of need, to better prepare Sailors and Marines to operate and maintain their equipment at its technological limits and meet rapidly evolving warfighting demands. The DON will also focus its safety education, tracking and oversight efforts on reducing both mishaps and non-combat fatalities, as well as improve its process for identifying and processing non-deployable personnel.

- Establish a learning and training continuum that will accelerate the performance of every Sailor, timed to optimize Fleet operational readiness

# Mixed/Augmented Reality (AR/MR) – Advancing the State of the Art for Instruction

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- **Augmented Reality experiences rapidly train your workforce on complex tasks, improve productivity, oversight and operations management, and maintenance accuracy.**
- **Augmented Reality allows the maintainer to experience the digital information and digital representation of the aircraft or equipment in the context of a physical product using digital twins, 3D overlays, augmented work instructions with IoT data in a safe environment with full scale or miniature representations in any location or environment.**



# Mixed/Augmented Reality (AR/MR) – Advancing the State of the Art for Instruction

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## USE OF AR IN AIRCRAFT MAINTENANCE TRAINING

June 2018



# Vuforia AR Empowers Front-Line Workers

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## Augmented Remote Assistance

### Vuforia Chalk App

- Easy access to remote experts
- Leverage existing devices
- Annotate on shared live view of environment

## Augmented Expert Guidance

### Vuforia Expert Capture

- Fast and easy creation of AR-enabled training and hands-on guidance
- No pre-existing assets required to create step-by-step instructions
- Efficient documentation of standards operating procedures

## Augmented 3D Work Instructions

### Vuforia Studio

- Efficient creation of scalable AR work instructions leveraging existing CAD
- Easily incorporate animated sequences
- Leverage IoT data to provide deeper situational understanding

## Augmented Training and Demonstration

### Vuforia Studio

- Utilize 3D CAD models to provide interactive digital twins of physical assets
- Real-time, on-the-job training and upskilling for new or unfamiliar tasks
- Train in or out of context of physical product or equipment





# Vuforia Product Portfolio



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The **fastest** and **easiest** way to capture and share **expert knowledge**

vuforia® expert capture™



The most **efficient** way to author and publish **scalable AR** for the **enterprise**

vuforia® studio™



The most **accessible** real-time, **remote expert guidance** app

vuforia® chalk™



The most **widely-used computer vision** s/w for custom AR apps

vuforia® engine

## *Real-time, Remote Assistance & Collaboration*

- **Accelerate** problem resolution
- **Reduce** cost of expert truck rolls
- **Improve** uptime and customer satisfaction



Facilitate  
Instant  
Collaboration



Precisely  
Annotate  
Directions



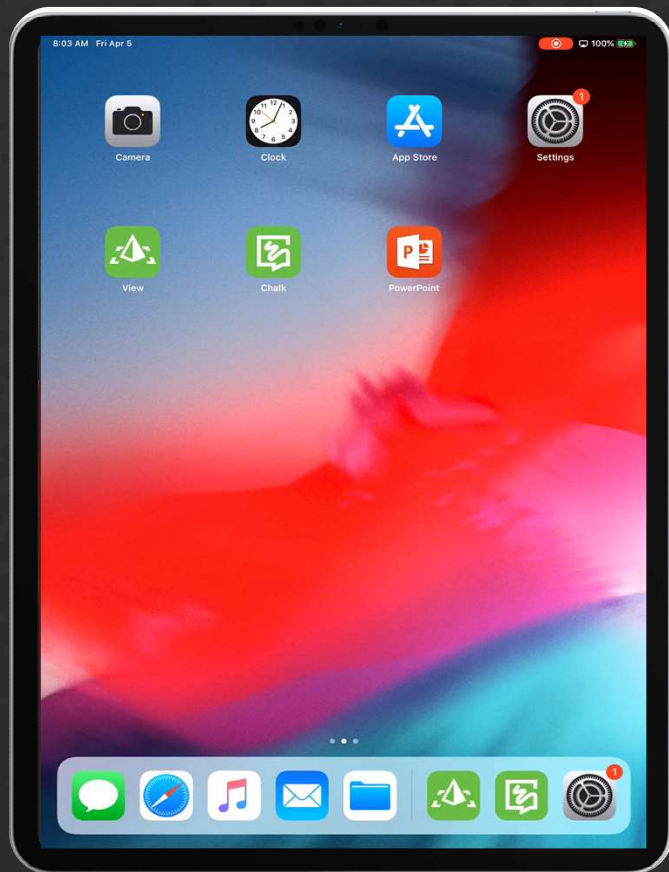
Improve  
Access  
to Experts



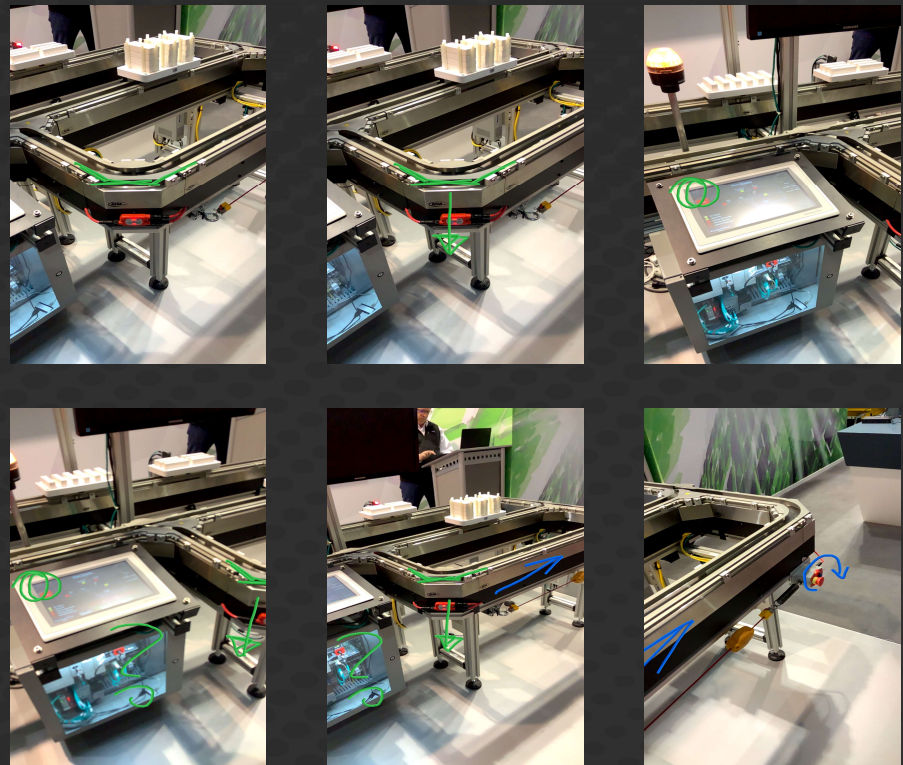
Leverage  
Existing  
Devices

# Immediately Access Remote Experts

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## SESSION SUMMARY





## *Fast and easy knowledge capture and sharing*

- **Increase** workforce productivity
- **Reduce** cost of errors and downtime
- **Improve** safety and compliance adherence



**Accelerate  
Content  
Creation**



**Simplify  
Knowledge  
Capture**



**Highlight  
Spatial  
Relevance**



**Effortlessly  
Scale  
Expertise**



# Creating AR content is As Easy as 1 – 2 – 3!

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- Easily record step-by-step instructions on how to perform critical tasks

**1) Capture  
expertise**



- Securely fine-tune, enhance, publish and manage content

**2) Enhance  
expertise**



- Dynamically deliver optimized content across the enterprise

**3) Scale  
expertise**

# Easily Capture and Share Critical Expertise

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## *Efficient, scalable AR authoring and publishing*

- **Boost** workforce safety and performance
- **Improve** assembly, quality & inspection
- **Increase** revenue & customer satisfaction



Accelerate  
Time-to-  
Value



Deliver  
Actionable  
IoT Insights



Streamline  
Enterprise  
Scalability



Precisely  
Display  
Information



# Thingworx - Industrial Innovation Platform



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- Built with the industrial technology used for connecting **5 million assets** at over **75,000 sites** around the world
- Benefitting from PTC's ongoing leadership in areas like CAD and PLM, ThingWorx has an **unmatched understanding** of how “things” are designed, operated and serviced
- Leveraging our experience and understanding of our industrial customers' needs, we have created a platform of unprecedented **simplicity, power, and flexibility**





# Create Compelling AR Content

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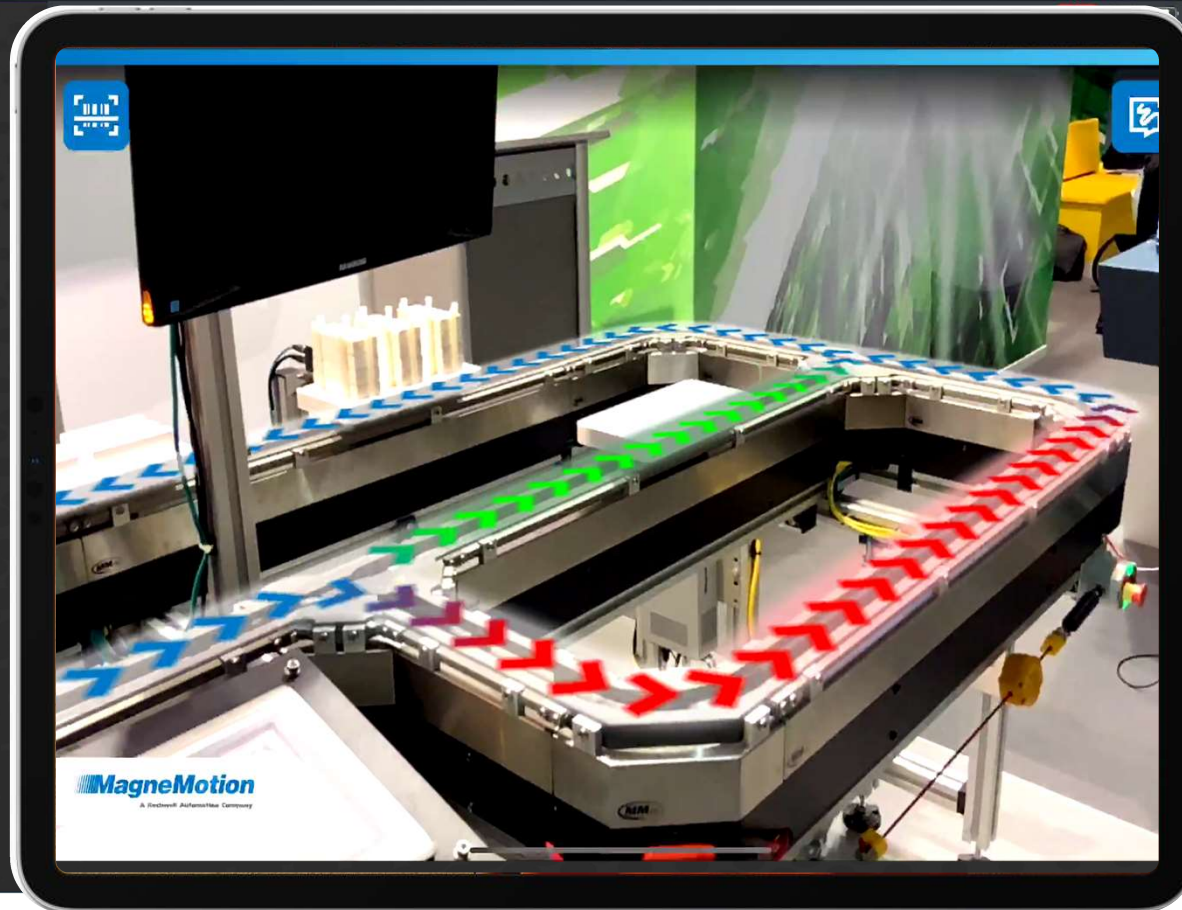


IMPROVING  
MAINTENANCE  
WITH  
AUGMENTED  
REALITY

vuforia® studio™

# Access and View Across the Enterprise

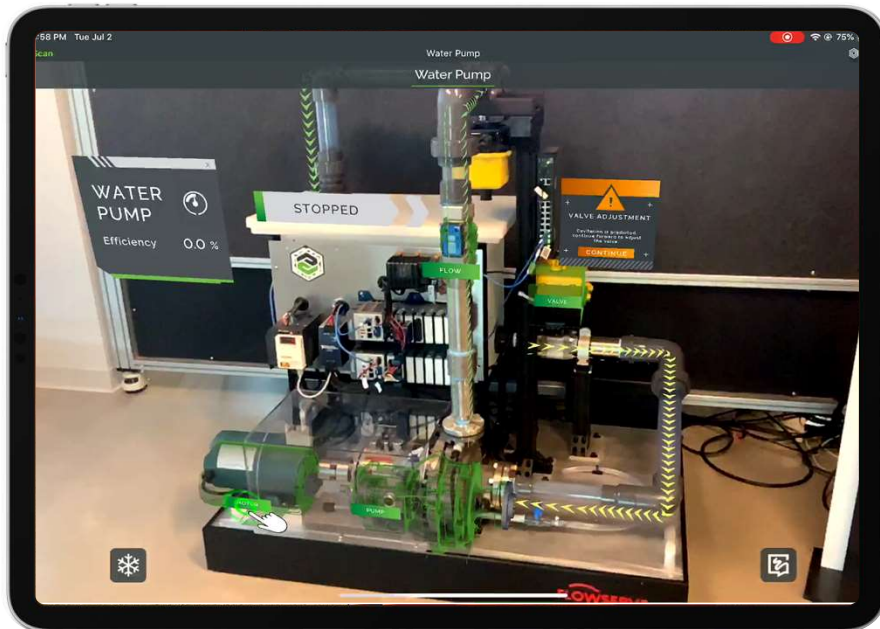
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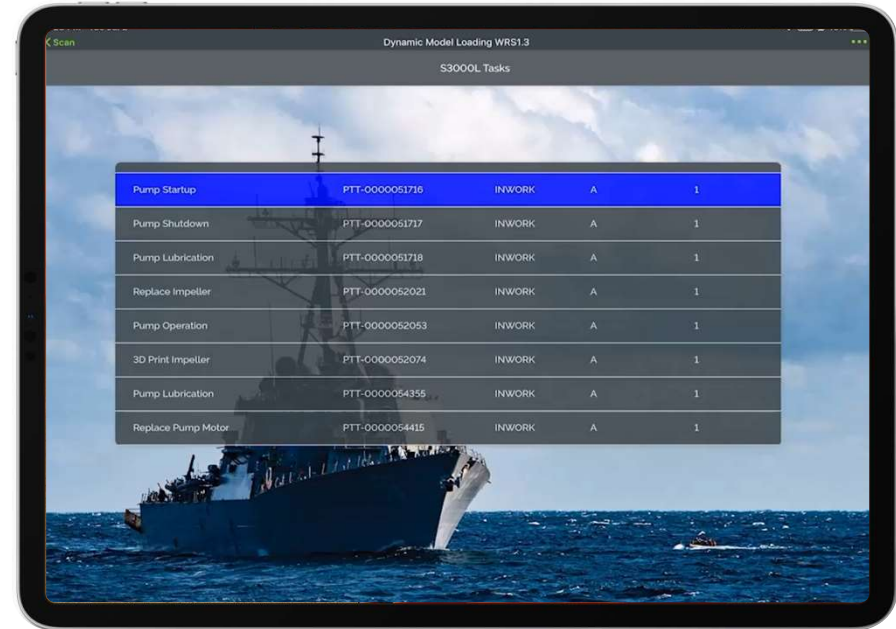
# PLM Connected Augmented Reality (Digital Thread)

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## AR with IOT Connected Pump Equipment (Digital Twin)



## AR with Connected Product Support Artifacts / Authoritative Data





# Vuforia Engine

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## *The World's Most Widely Deployed AR*

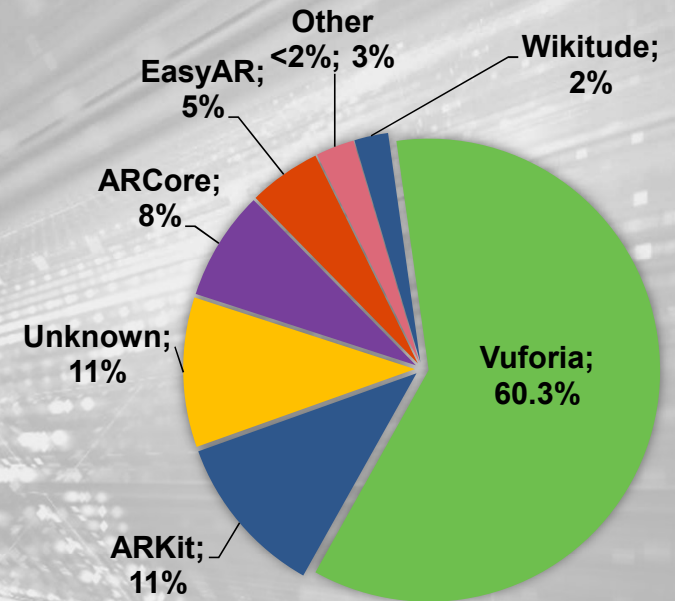
- **Increase** brand value and differentiation
- **Improve** customer engagement
- **Ensure** excellent user experiences

600K+

REGISTERED DEVELOPERS

60K+

COMMERCIAL APPS



Deliver  
Unique AR  
Experiences



Leverage  
Advanced  
Technology



Reach  
Broadest  
Audience



Build  
Branded  
AR Apps



# View Content on your favorite devices

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Mobile



3D Eyewear



M300  
VUZIX

realwear  
hmt-1

2D Eyewear

# AR Benefits

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- **Improve retention, understanding of tasks**
- **Reduce errors and improve quality**
- **Empower technicians with step-by-step work instructions**
- **Enhance operator efficiency – work faster**
- **Rapid problem detection/resolution – with remote assistance**

## Success Stories

- **Up to 50% reduction in training time (GlobalFoundries)**
- **Installation reduction time of up to 60% (AGCO)**
- **50% improvement in assembly (BAE)**
- **20-30% improvement in training rates (BAE)**
- **32% more productive workforce (Industry Report on AR)**
- **30% Higher quality output (Industry Report on AR)**
- **40% Higher on the Job Training retention (Industry Report on AR)**



**BAE SYSTEMS**

# Thank You!

Contact info  
Questions?

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