

AUGMENTED REALITY IN THE ENTERPRISE

Michael Campbell



ptc

forum
europe



AGENDA

- Trends – Challenges - Business Needs
- How AR addresses
- AR challenges
- Content Pipeline
- Products Today
- What's coming

WHAT SHOULD YOU KNOW ABOUT AUGMENTED REALITY



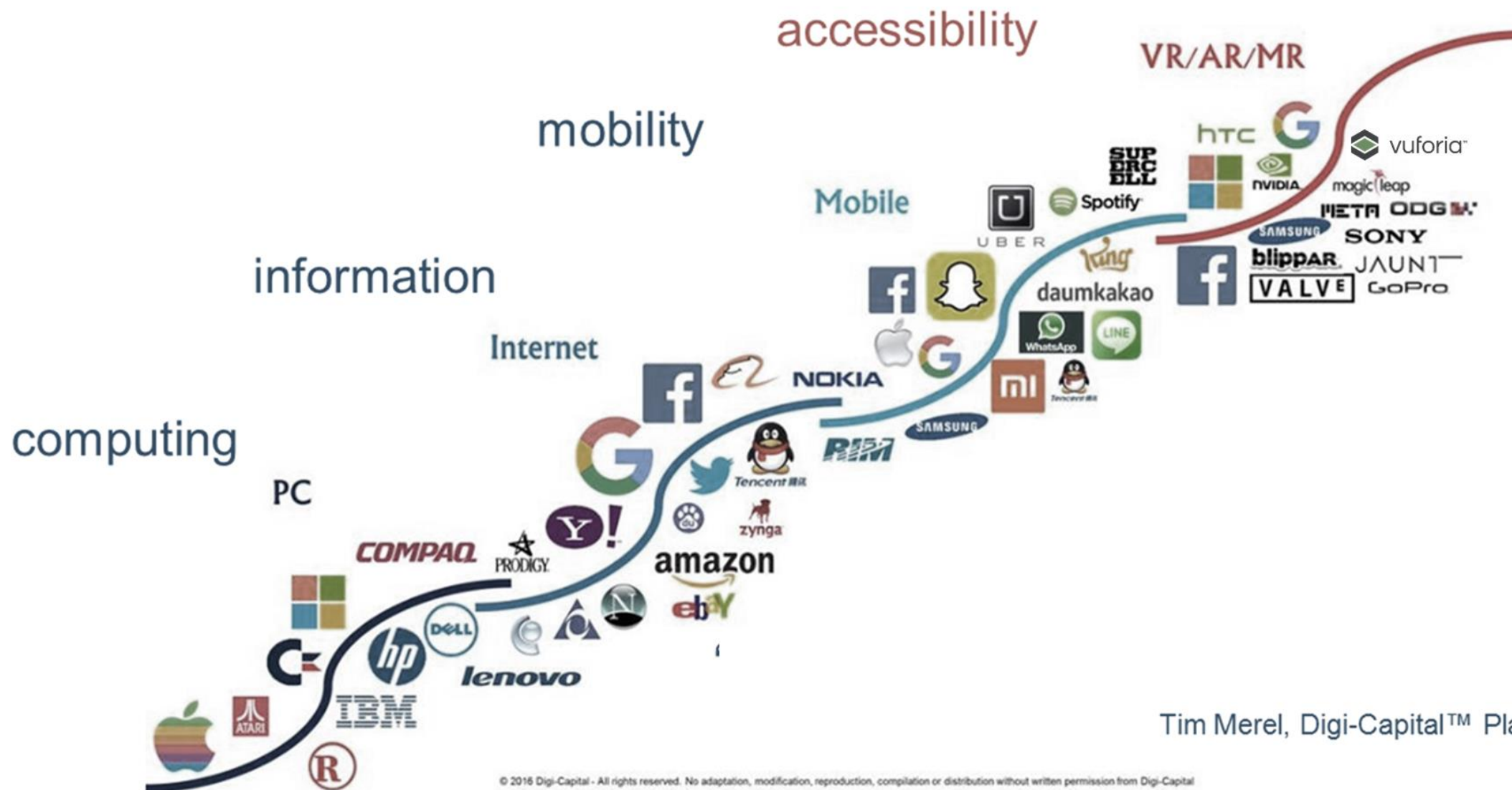
“ A large percentage of companies have already recognized this revolutionary technology and are moving fast to embrace it. If your company has a focus in any of the key areas — from services to training to sales and marketing to manufacturing — **it is time to get started.**”

Tom Mainelli, IDC

Whitepaper: How Augmented Reality Drives Real-World Gains
in Services, Training, Sales & Marketing, and Manufacturing

Sourced from 100 companies.
Average of 2.3 functional areas checked by respondent.

AR IS THE FOURTH MAJOR PLATFORM SHIFT



Tim Merel, Digi-Capital™ Platform Waves



INDUSTRIAL AUGMENTED REALITY



ACCELERATING THE VALUE OF MIXED REALITY
IN THE INDUSTRIAL ENTERPRISE

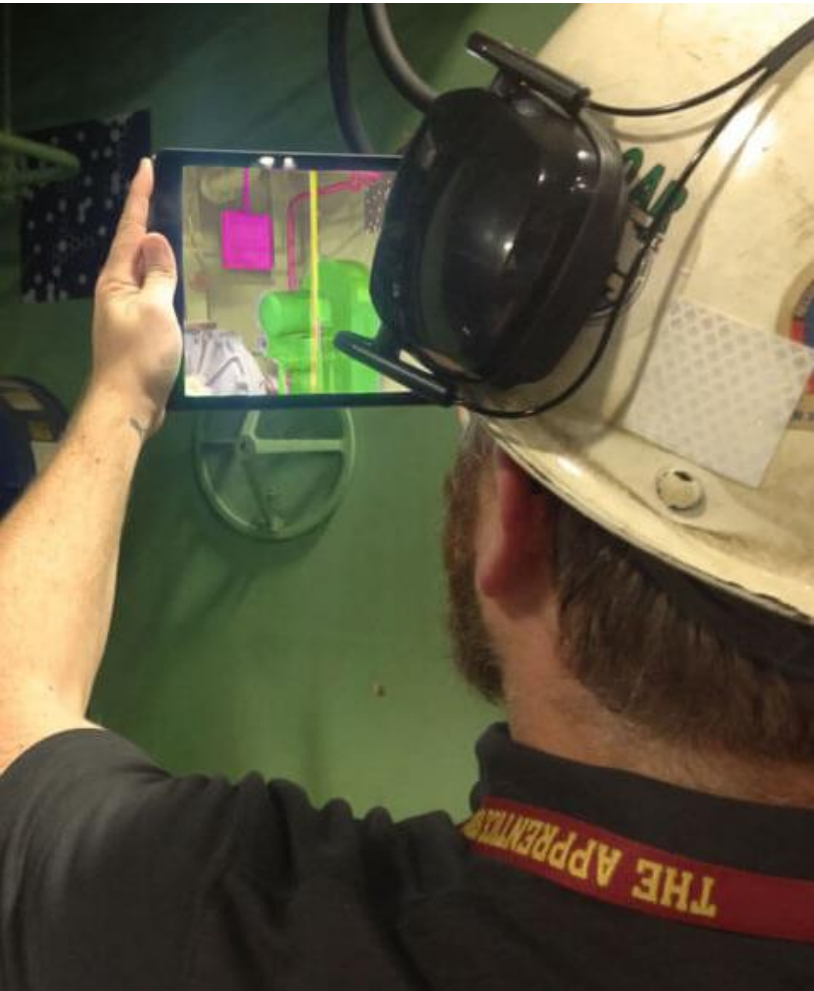
Aligning our respective strategies and solutions for
“Smart, Connected Operations” and “The Connected Enterprise”
to more rapidly deliver value for industrial customers.

Rockwell
Automation



JOINING FORCES TO ACCELERATE DIGITAL
TRANSFORMATION

WHAT'S HAPPENING IN THE INDUSTRY?



WHAT'S DRIVING AR IN THE INDUSTRIAL ENTERPRISE?



Disappearing Workforce

"Over the next two decades the global economy faces the largest exodus from the workforce of any generation history"

(Deloitte)

Manufacturing Productivity

"3.5 million manufacturing jobs available over the next decade in the US, 2 million of which will go unfilled."

(Deloitte)

Declining Profitability

"33% of enterprises report that one hour of downtime costs their firms \$1 million to over \$5 million."

(ITIC)

Increasing Revenue

"Aftermarket services represent approximately 24% of total revenue, often contributing 40 – 80% of profit"

(Gartner, SLM Maturity Model)

The growing shortage of skilled manufacturing workers

Productivity growth is the weakest since early 1980s



Worker Skill Gap

31% turnover rate¹

10 million jobs unfilled²

Ongoing skills upgrading

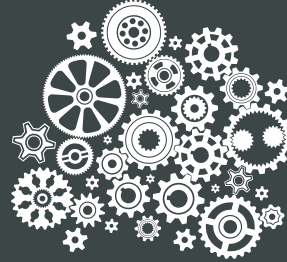


Worker Skill Gap

31% turnover rate¹

10 million jobs unfilled²

Ongoing skills upgrading



Complex Products & Workspaces

Service/maintenance challenge, configurations

Information access & content creation

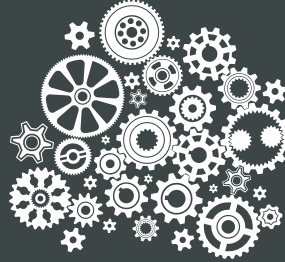


Worker Skill Gap

31% turnover rate¹

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Complex Products & Workspaces

Service/maintenance challenge, configurations

Information access & content creation



Increased Customer Demands

Expectations of immediacy

Fiercely competitive & shifting marketplace



Worker Skill Gap

31% turnover rate¹

10 million jobs unfilled²

Ongoing skills upgrading

PRODUCTIVITY



Complex Products & Workspaces

Service/maintenance challenge, configurations

Information access & content creation

EFFICIENCY & EFFECTIVENESS



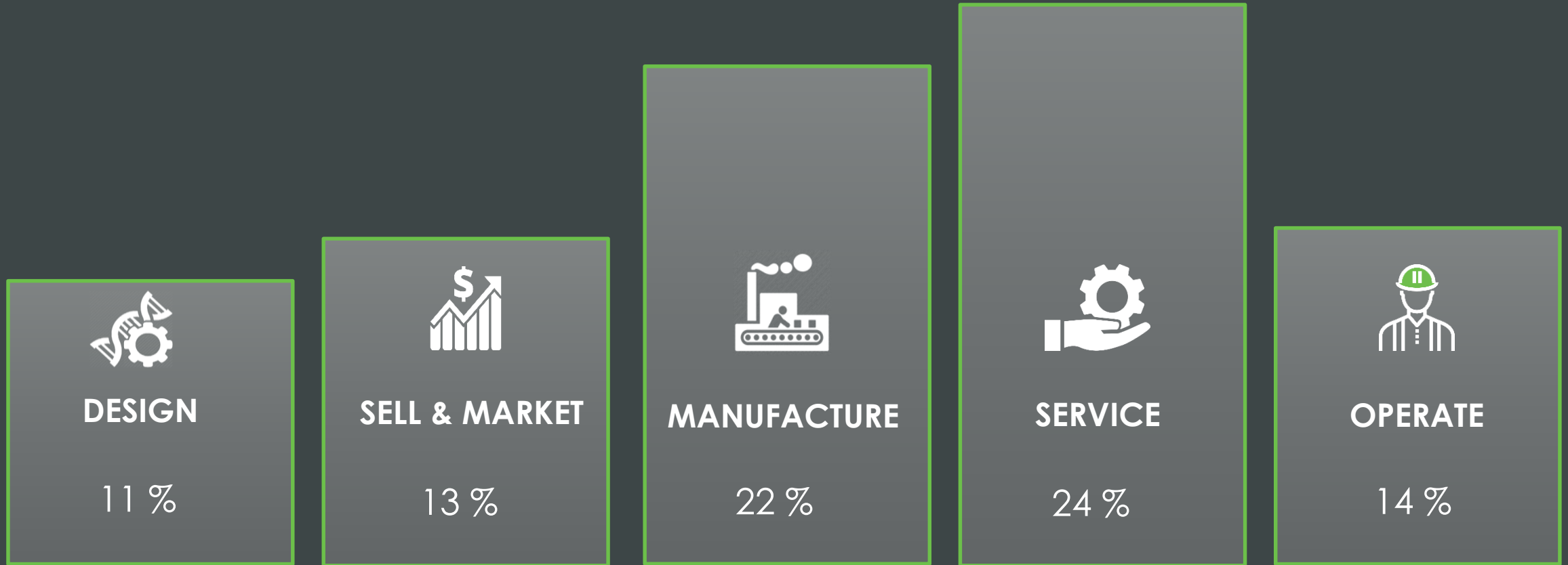
Increased Customer Demands

Expectations of immediacy

Fiercely competitive & shifting marketplace

DIFFERENTIATION

MANUFACTURING AND SERVICE PRESSURES TODAY



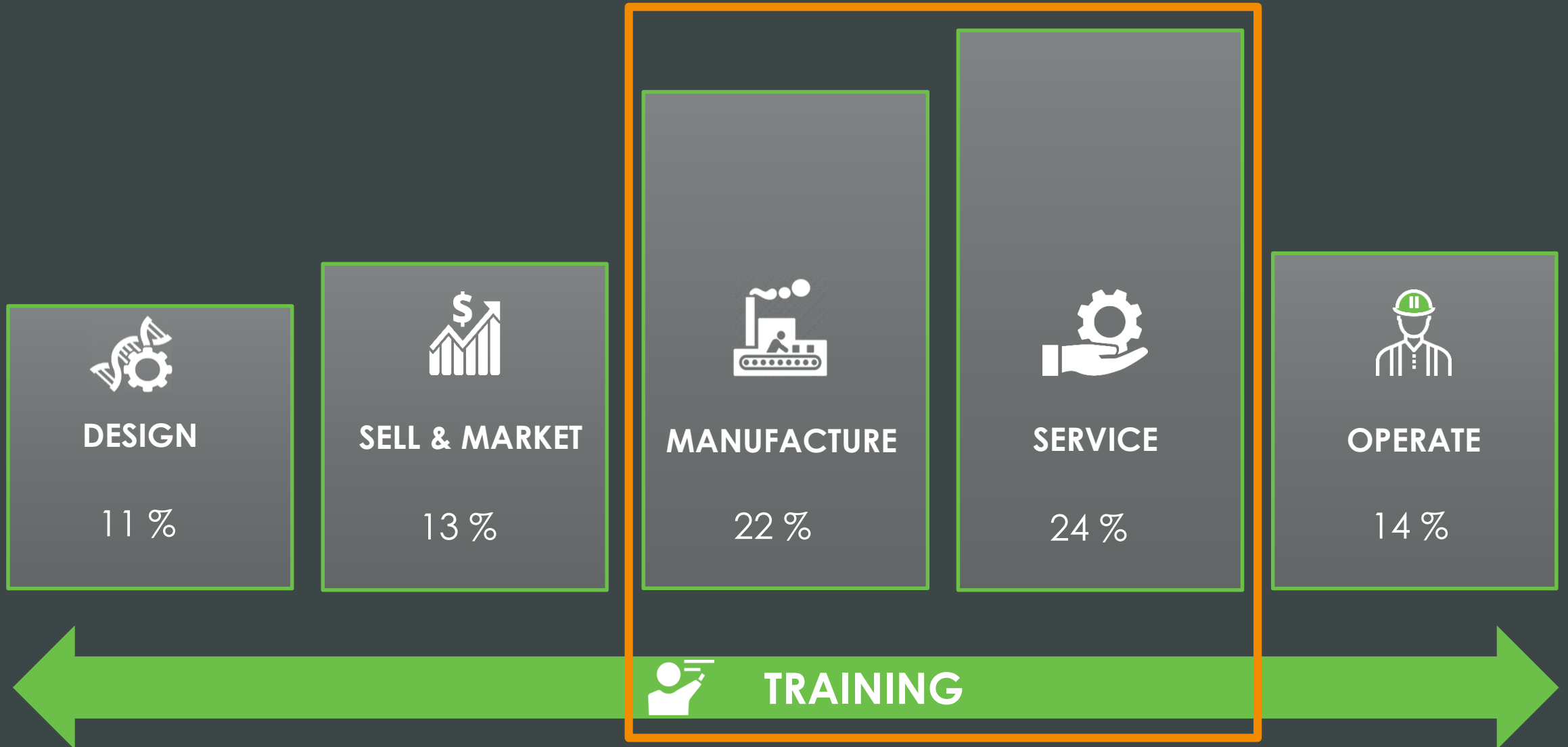
Sample of 195 companies
Average of 5 use cases and 2.2 functional areas chosen per respondent

MANUFACTURING AND SERVICE PRESSURES TODAY



Sample of 195 companies
Average of 5 use cases and 2.2 functional areas chosen per respondent

MANUFACTURING AND SERVICE PRESSURES TODAY



Sample of 195 companies
Average of 5 use cases and 2.2 functional areas chosen per respondent

HIGHEST VALUE USE CASES



MANUFACTURE

Augmented Work Instructions

- ✓ Improve Productivity & Reduce Operational Cost

Remote Expert Guidance

- ✓ Improves Communication & Reduces Downtime



SERVICE

Augmented Service Instructions

- ✓ Improve Efficiency & Provide Differentiation

Remote Expert Guidance

- ✓ Speed Troubleshooting & Lower Costs



Augmented Training

- ✓ Close the Skills Gap and Reduce Time & Cost of Onboarding



Manufacturing Benefits

- ✓ **70%** Increased efficiency
- ✓ **60%** Decreased training time
- ✓ **42%** Improved accuracy



Service Benefits

- ✓ **66%** Improved knowledge transfer
- ✓ **60%** Employees more efficient
- ✓ **50%** Effectiveness / FTF – rates

AUGMENTED REALITY



cannondale

IMPROVING AFTER-MARKET SERVICE WITH AR

Before

- Multiple, similar forks with similar components
- Challenges configuring equipment for optimal use

After with AR

- Deliver augmented reality experiences
- Identify components for easier order of replacement parts
- Improve user experience with configuration information (air pressure)





DRIVING MANUFACTURING EFFICIENCY



“We created work instructions that we were able to **deliver to the production floor in hours.** And at a tenth of the cost.”

Fran Piascik
Senior Project Manager
Engineering Innovation

BAE SYSTEMS

HybriDrive
PROPULSION SYSTEMS

50% FASTER
ASSEMBLY



AR CHALLENGES IN THE INDUSTRIAL ENTERPRISE

COMPUTER VISION



HARDWARE



CHIPS



DISPLAYS

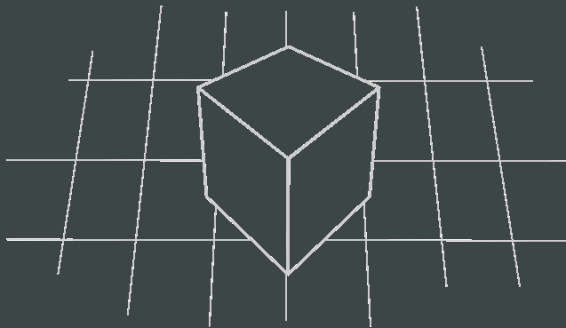


BATTERIES



SENSORS

CONTENT CREATION



SUBJECT MATTER EXPERTISE



THERE IS TREMENDOUS VALUE IN INDUSTRIAL AR, BUT...

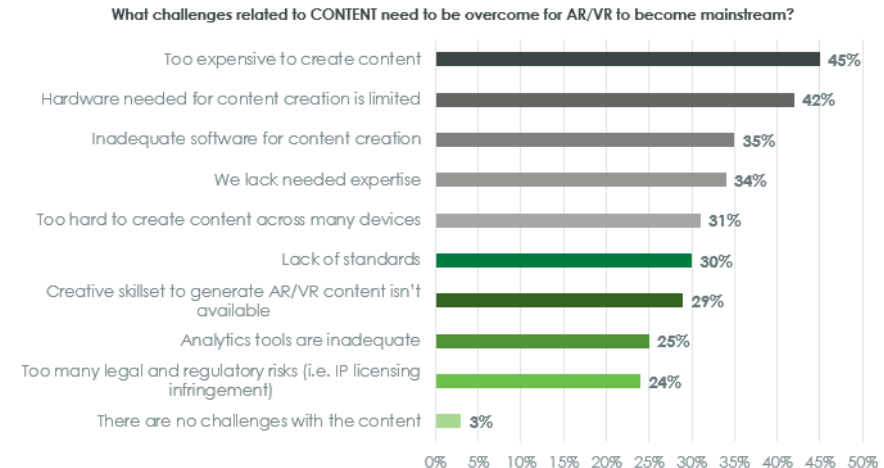


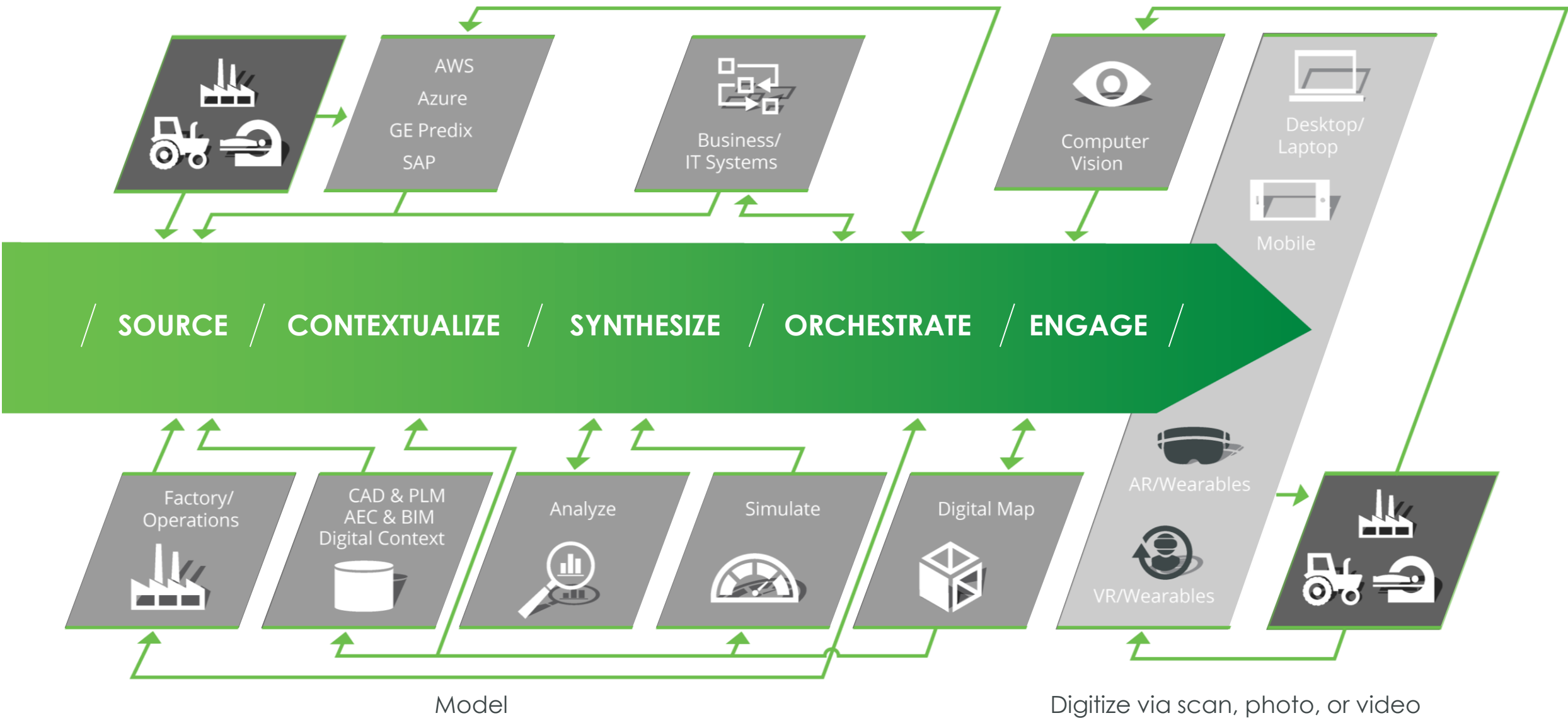
...apart from digital eyewear readiness,
the single **largest barrier to AR adoption is
cost and effort of creating content.**

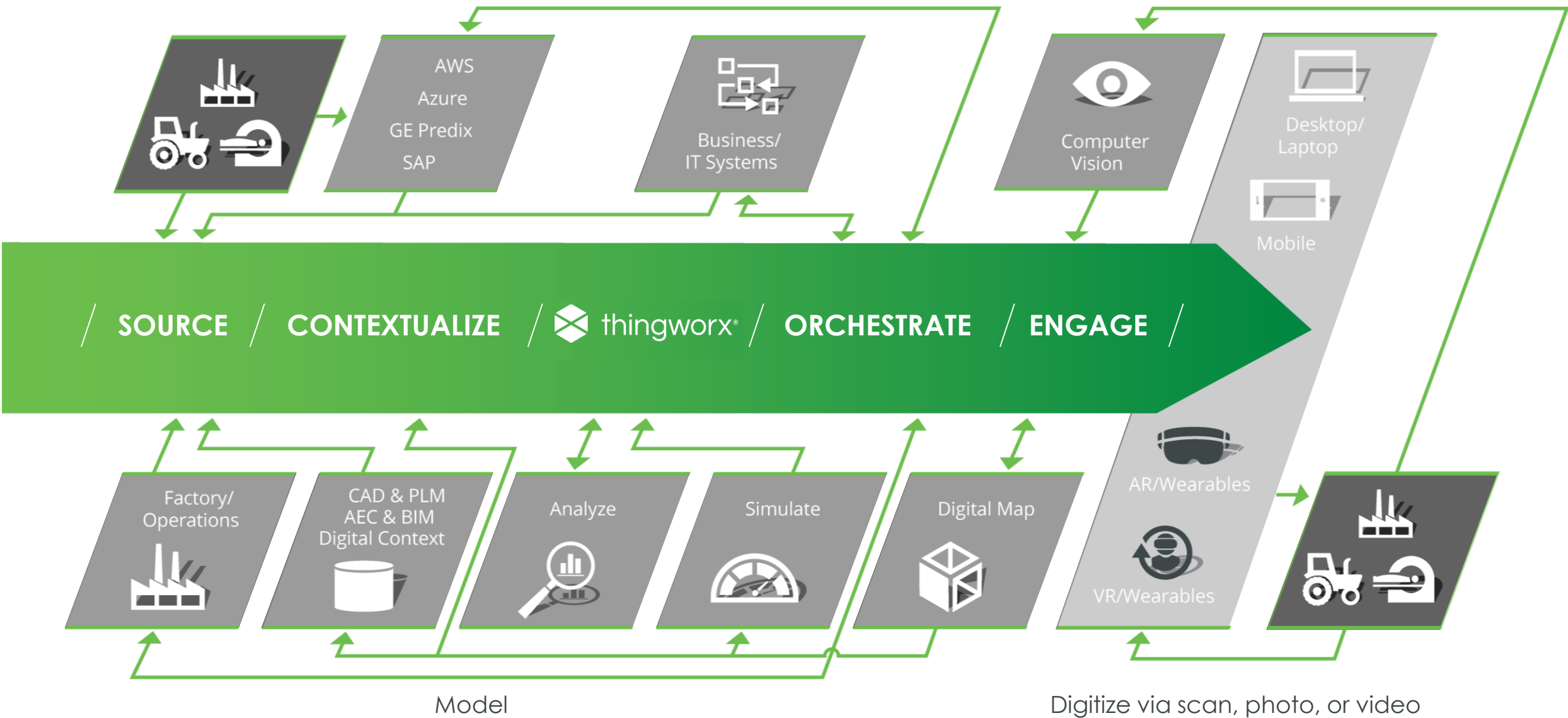
- A recent report from Dimensional Research reported “**97% of participants cite AR/VR content challenges to overcome**”
 - Too expensive to create content
 - Inadequate software for content creation
 - We lack needed expertise
 - Creative skill set to generate AR/VR content isn't available

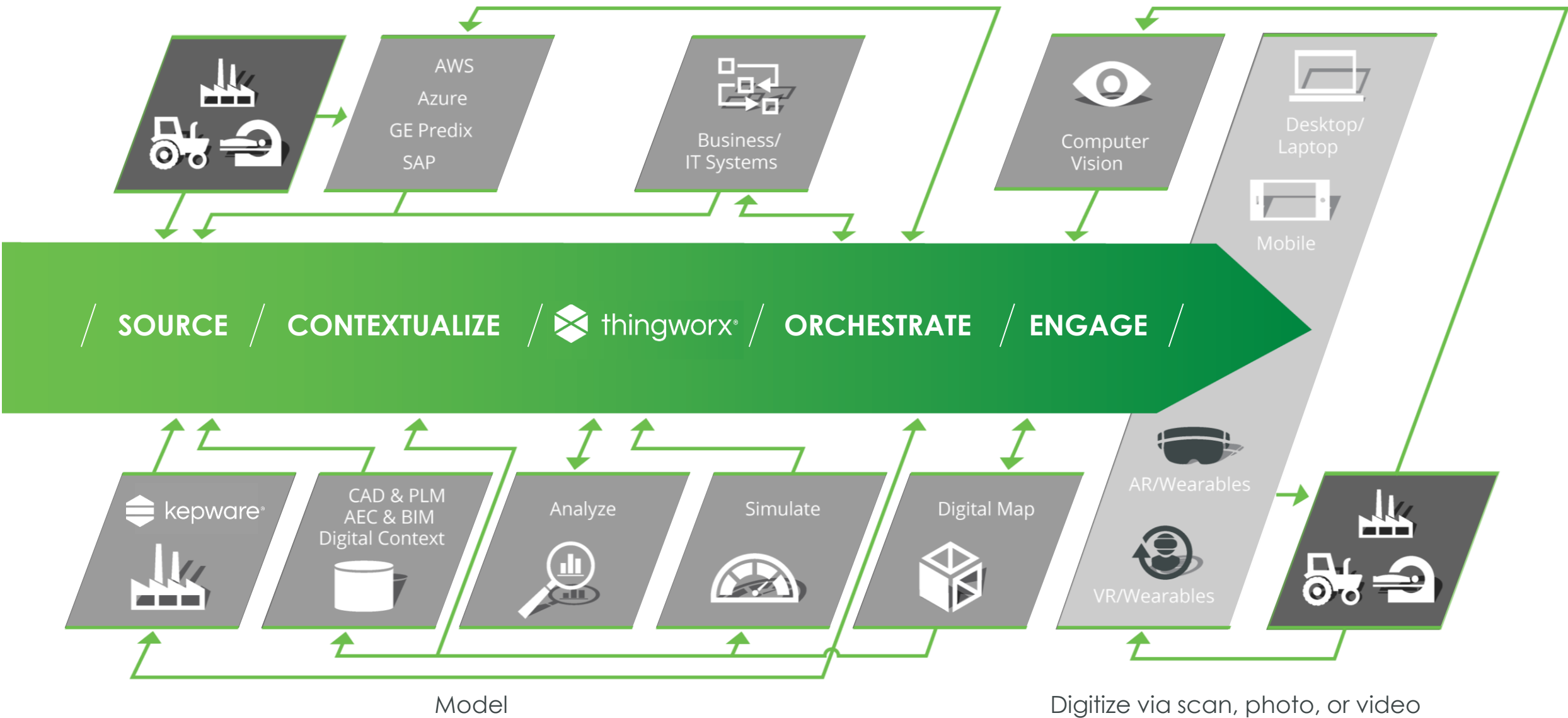
COMPANIES FACE BOTH TECHNOLOGY AND CONTENT CHALLENGES

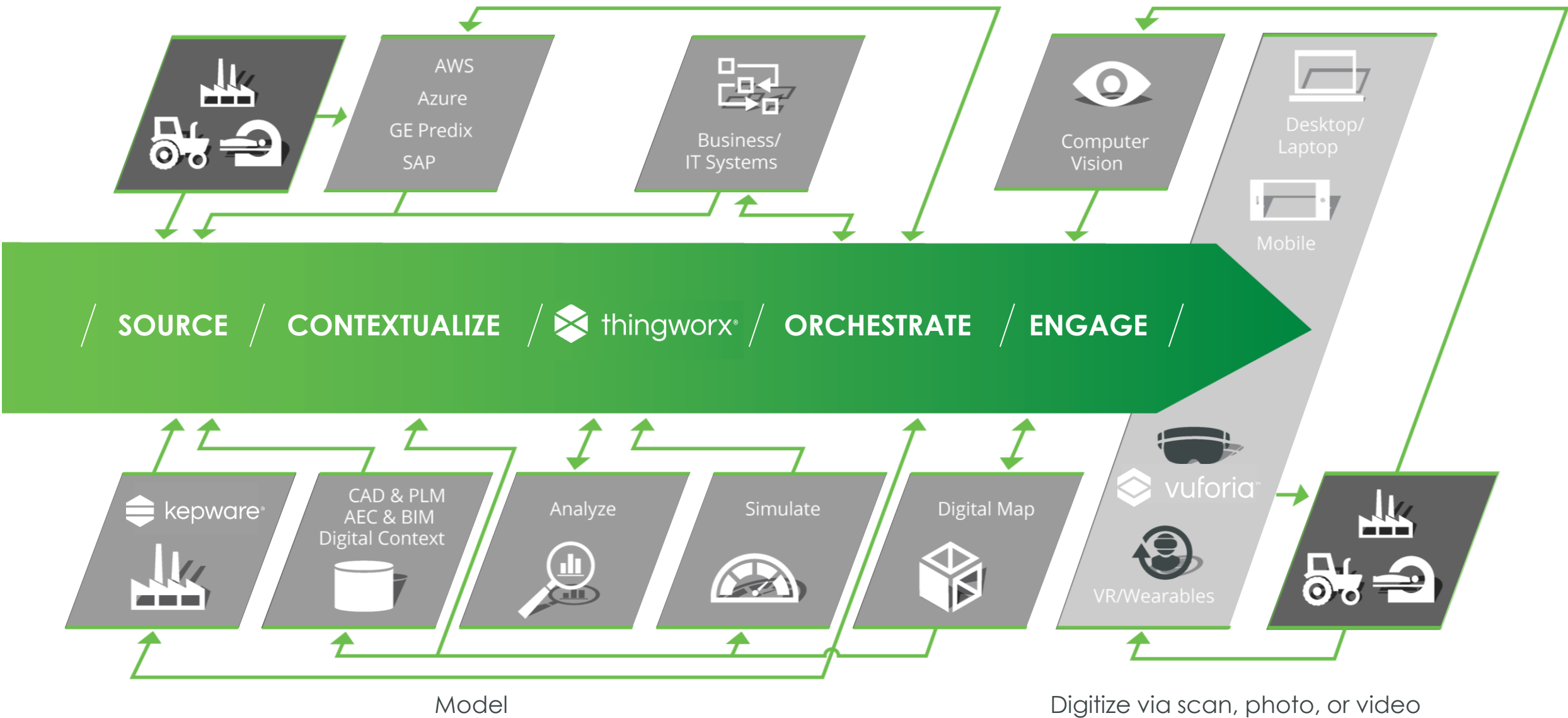
- Similarly, 97% of participants cite AR/VR content challenges to overcome with high content expenses (45%), limited hardware (42%), and inadequate software (35%) at the top of the list.











VUFORIA DELIVERS PROVEN RESULTS TO CUSTOMERS IN MANUFACTURING AND SERVICE



- **MARKET-LEADING AR TECHNOLOGY**
 - Precise, reliable tracking and computer vision
 - Cross-platform support
- **FAST, SCALABLE AR AUTHORIZING**
 - Faster time-to-value with drag and drop AR authoring at scale
 - Create easily-consumable instructions with existing 3D CAD, sequences, IoT data and media content
- **INDUSTRIAL EXPERTISE**
 - PTC's 30 years of experience serving industrial customers
 - Industry partnerships with Microsoft and Rockwell Automation





vuforia™



Offerings In The Market Today

vuforia® studio™

For Content Creators

- Scalable AR authoring and publishing solution for industrial enterprises



vuforia® engine™

For Developers

- Flexible AR development toolkit when building custom apps from the ground up



vuforia® chalk™

For Remote Assistance

- Easy-to-use mobile AR collaboration tool for real-time remote guidance



SCALABLE, EFFICIENT AR AUTHORIZING & PUBLISHING



Vuforia Studio - efficiently create scalable AR experiences for industrial use cases



Vuforia View - access and share AR experiences across the industrial enterprise

VUFORIA STUDIO

**CREATE GAME-CHANGING
AR CONTENT IN MINUTES!**

vuforia® engine

For Developers

- The most widely used AR platform for handheld devices & digital eyewear
- Allows Apps to “see”



Image Targets & VuMarks

Identify Things and align digital content to them



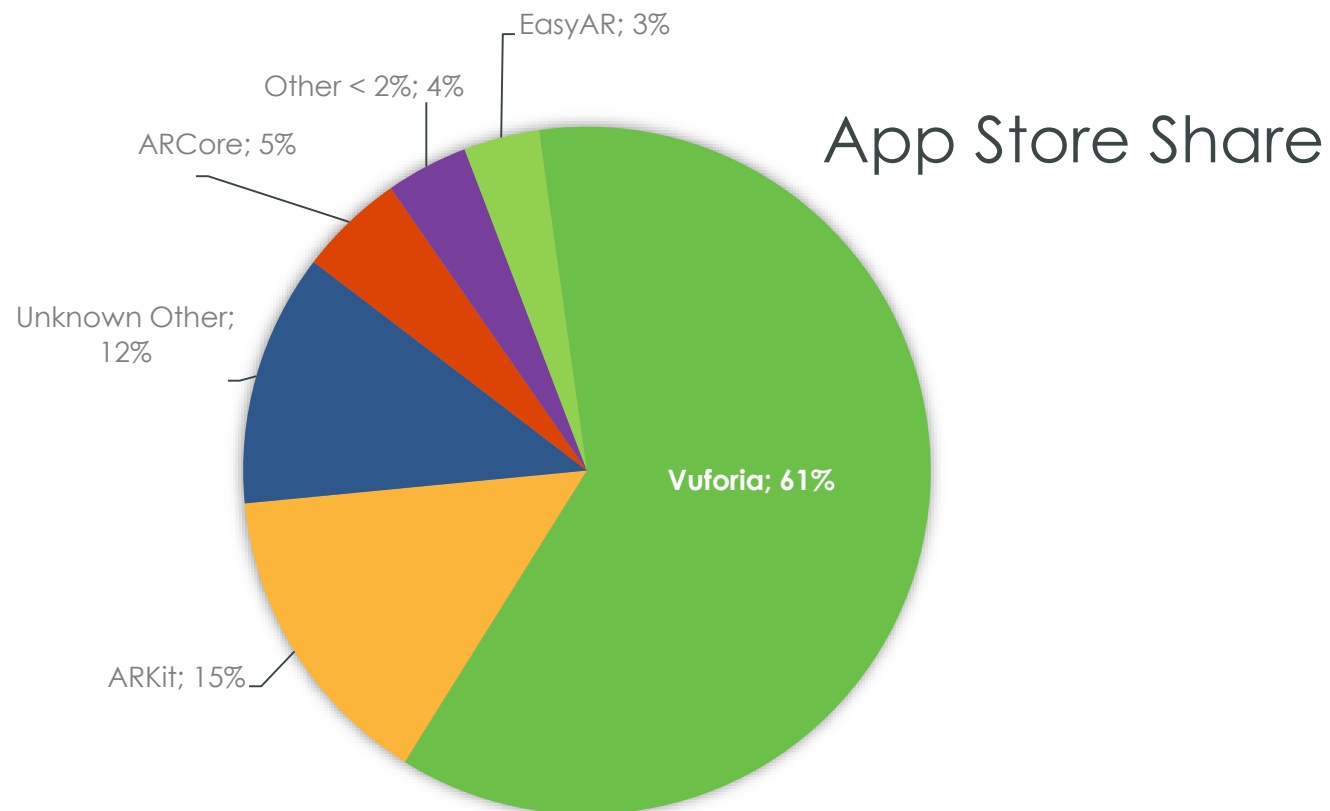
Ground Plane

Enables content to be placed on horizontal planes



Model Targets

Objects of any size with a distinctive contour



550K+

REGISTERED
DEVELOPERS

60K+

COMMERCIAL
APPS

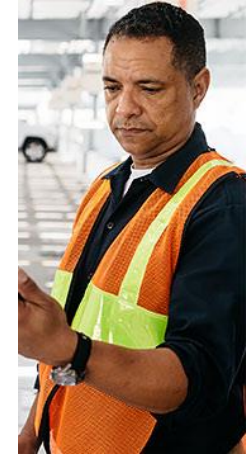
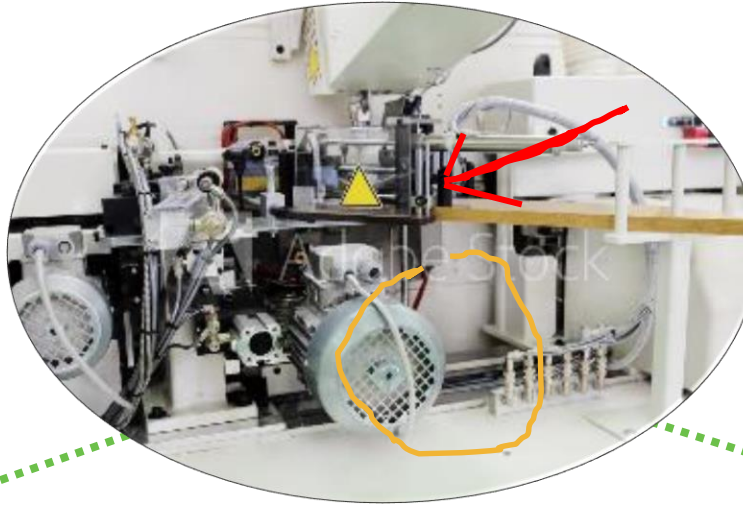
600M+

APP
INSTALLS

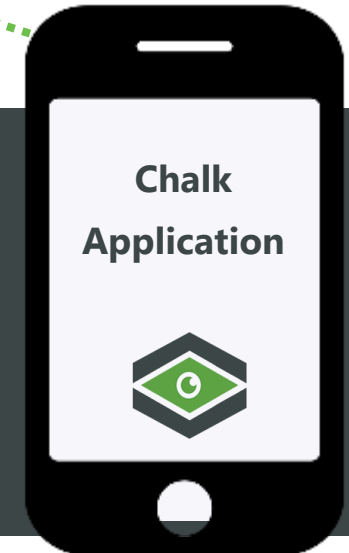
VUFORIA ENGINE

WORLD'S MOST WIDELY USED
AR PLATFORM

EASY-TO-USE, REAL-TIME REMOTE EXPERT GUIDANCE



Vuforia Chalk is an app which connects service technicians or frontline workers with remote experts within their organization.



VUFORIA CHALK

REMOTE EXPERTISE
AT YOUR FINGERTIPS

PROJECTS IN DEVELOPMENT

Location-based, in-situ capture and playback, for Training and Instruction

New **AR authoring and publishing capability** that enables operators to author and capture procedures in situ – when and where they work.



Location-based, Dynamic Delivery of Content for Augmenting Large Spaces

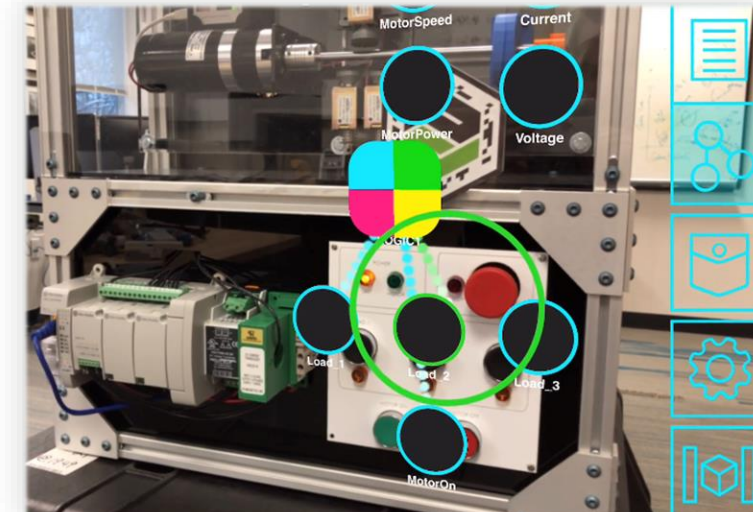
New capabilities to allow a user to walk into a **large space**, and be **dynamically presented with experiences** based on context and location



Reality Editor

For Programming in AR

Reality Editor provides breakthrough technology to **program logic and interaction between connected devices** in the context of the real world, using Augmented Reality.



LOCATION-BASED, IN-SITU CAPTURE AND PLAYBACK, FOR TRAINING AND INSTRUCTION



Will enable operators to author and capture procedures in situ – when and where they work.

Procedures are then intelligently presented back to trainees, using Augmented Reality, enabling the world's 2 billion front line workers.





Place in -20° Celsius fridge

A woman wearing a white lab coat and a VR headset is shown in a laboratory setting. She is reaching towards a yellow storage container with a white lid. The container has a label that reads "Credo" and "Bioscience". She is also wearing a purple wristband.



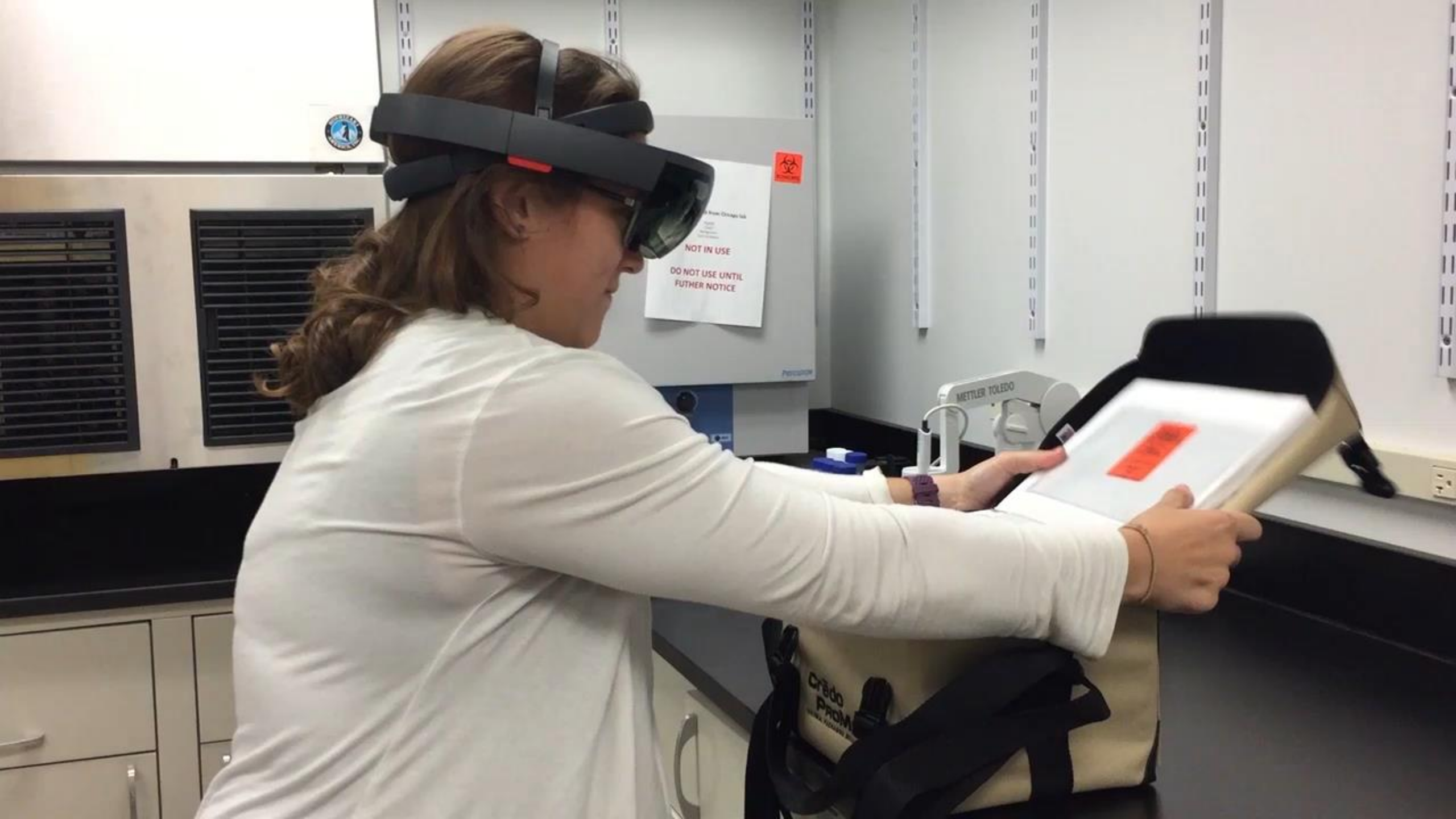
Dispense 5mL

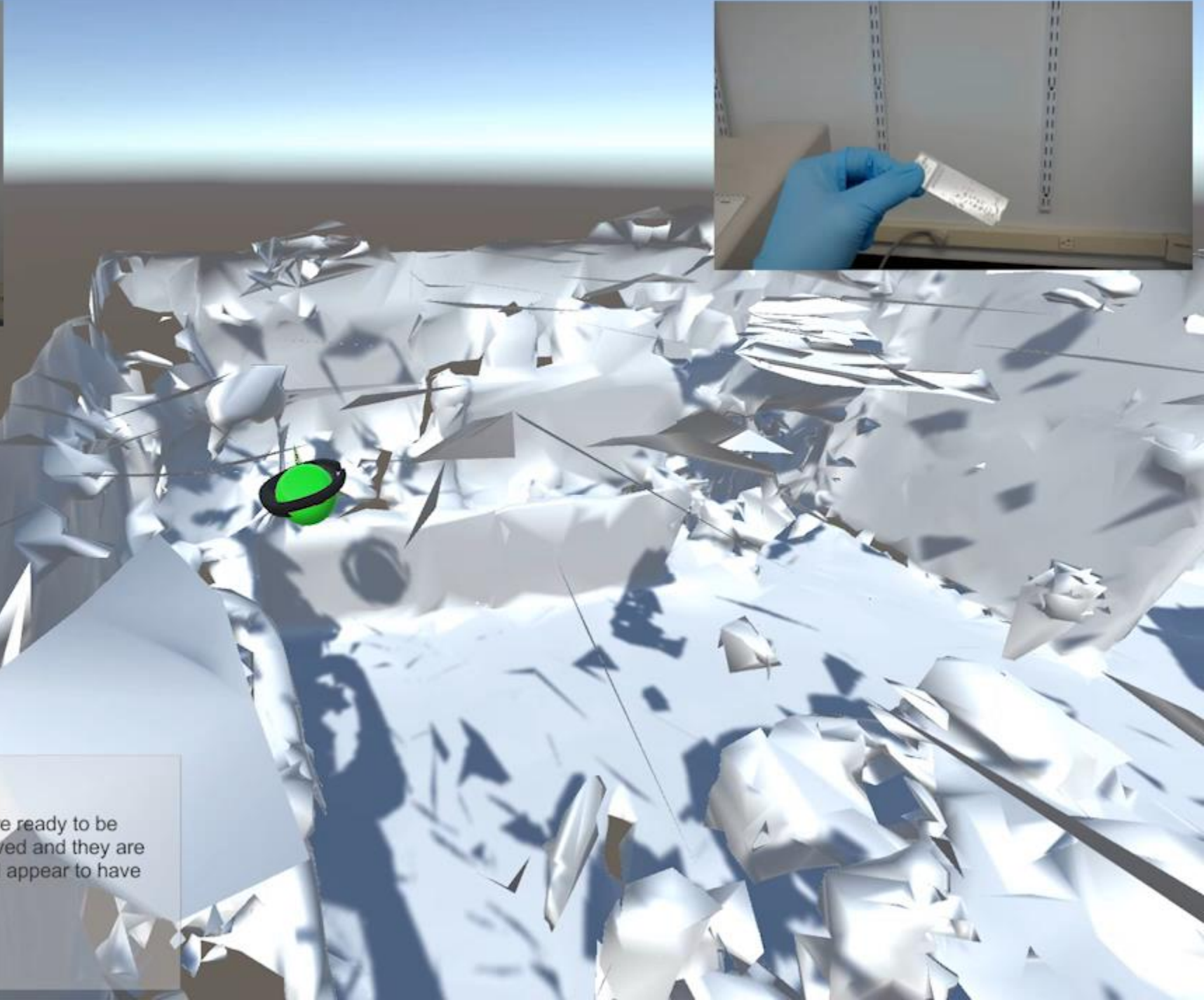
A woman wearing a white lab coat and a VR headset is shown in a laboratory setting. She is wearing blue gloves and is using a pipette to dispense liquid into a multi-well plate. There are several other pipettes and lab equipment visible in the background.



Take a picture

A woman wearing a white lab coat and a VR headset is shown in a laboratory setting. She is wearing green gloves and is holding a petri dish. She is looking down at the petri dish. There is a name tag on her lab coat that says "Laura".





Step 1 of 15

This procedure is for the Leica Bond Max. Once tissue slides are ready to be taken out of the oven after an hour of baking, they can be removed and they are considered to be ready to go on the Bond. A baked slide should appear to have the wax melted and dripped off of the tissue.

SPECIMEN TRANSITION KIT ASSEMBLY

1. **Purpose:** To prepare the Credo kit for shipping to the hospital so the hospital staff can collect the sample and return it to [AlphaBiosci](#).
2. **Scope/Policy:** n/a
3. **Definitions:** n/a
4. **Materials**
 - 4.1. **Equipment**
 - 4.1.1. -20°C degree freezer (Utility Room)
 - 4.2. **Supplies**
 - 4.2.1. Credo transport kit with [Alpha](#) foam insert - Supply Room
 - 4.2.2. Transform buffer tube - Specimen Receiving Room
 - 4.2.3. Blood tubes - Supply Room
 - 4.2.4. Specimen Collection Form (SCF) - Specimen Receiving Room
 - 4.2.5. Return shipment bag - Supply Room
 - 4.2.6. Shipping labels (outbound & inbound) - Supply Room

5. **Quality**
 - 5.1. **Responsibilities**
 - 5.1.1. The laboratory director or designee must ensure that all employees comply with this procedure.
 - 5.2. **Safety Precautions**

Procedure



- 6.1. Collect a Credo transport kit from the Store Room

Page 1 of 12

- 6.2. Take the Credo transport kit to the Utility Room



- 6.3. Remove the TIC panel from the insulator box of the Credo transport kit



- 6.4. Place the TIC panel in the -20°C freezer for a minimum of 15-18 hours.

Page 2 of 12



- 6.5. After at least 15 hours have passed, remove the TIC panel from the -20°C freezer.
Note: The freezer is vacuum sealed and takes extra effort to open.



- 6.6. Incubate the TIC panel in room temperature for 30 minutes. Place a paper towel underneath to reduce condensation on counter surface. Set a timer for 30 minutes.

Page 3 of 12



- 6.7. While waiting for the TIC panel to incubate, prepare the remainder of the transport kit. Collect a Specimen Preparation and Shipment form.



- 6.8. Collect a Specimen Collection Form and note the form number and the Credo transport kit number (to be used for the bag).



- 6.9. Put the Return Shipping Label and the Specimen Preparation and Shipping Instructions together.

Page 4 of 12



- 6.10. Collect a return shipment bag. Affix the Return Shipping Label on the return shipment bag.



- 6.11. Check if the Credo insulator box has a plastic sleeve insert underneath the lid. If not, collect a new plastic sleeve from the Store Room and affix it under the lid.

Page 5 of 12



- 6.12. Place the return shipping bag, the Sample Collection Form, and the Specimen Preparation and Shipping Instructions together in the plastic sleeve insert. Minimize the paper sticking out of the insert because it may be damaged by condensation from the TIC panel.

- 6.13. Collect a new cardboard shipping box, unfold it, and securely tape the bottom closed.

- 6.14. After the TIC panel has been incubating for 25 minutes, begin collecting the buffer tube and blood tubes.



- 6.15. Take two blood tubes from the Storage Room and check the expiration dates. Take the oldest tubes first.

Page 6 of 12



- 6.16. Collect a transport buffer tube from the refrigerator in the Specimen Receiving Room. Check the buffer separation date on the tube. Take the oldest buffer tube first.



- 6.17. Wipe the excess moisture from the buffer tube



- 6.18. After the TIC panel has incubated for 30 minutes, wipe off any water condensation on the outside.

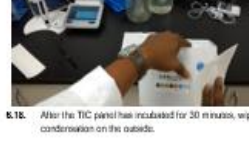
Page 7 of 12



- 6.17. Wipe the excess moisture from the buffer tube



- 6.18. After the TIC panel has incubated for 30 minutes, wipe off any water condensation on the outside.



- 6.18. After the TIC panel has incubated for 30 minutes, wipe off any water condensation on the outside.

Page 8 of 12



- 6.19. Place the buffer tube and the blood tubes in the foam. Carefully push the tube all the way to the bottom of the container. If there is no foam in the container, new foam inserts are located in the Store Room.



- 6.20. Place the TIC panel inside the Credo insulator box. Discard any old packing slips, etc. that may still be inside the insulator box.



- 6.20. Place the TIC panel inside the Credo insulator box. Discard any old packing slips, etc. that may still be inside the insulator box.

Page 9 of 12



- 6.21. Close the insulator box and tighten the straps. The insulator box (not the TIC panel) creates the vacuum seal so tight straps ensure that the top cannot move.



- 6.22. Place the kit inside the cardboard box.



- 6.23. Seal the box.

Page 10 of 12



Step 1

Step 3

Step 4

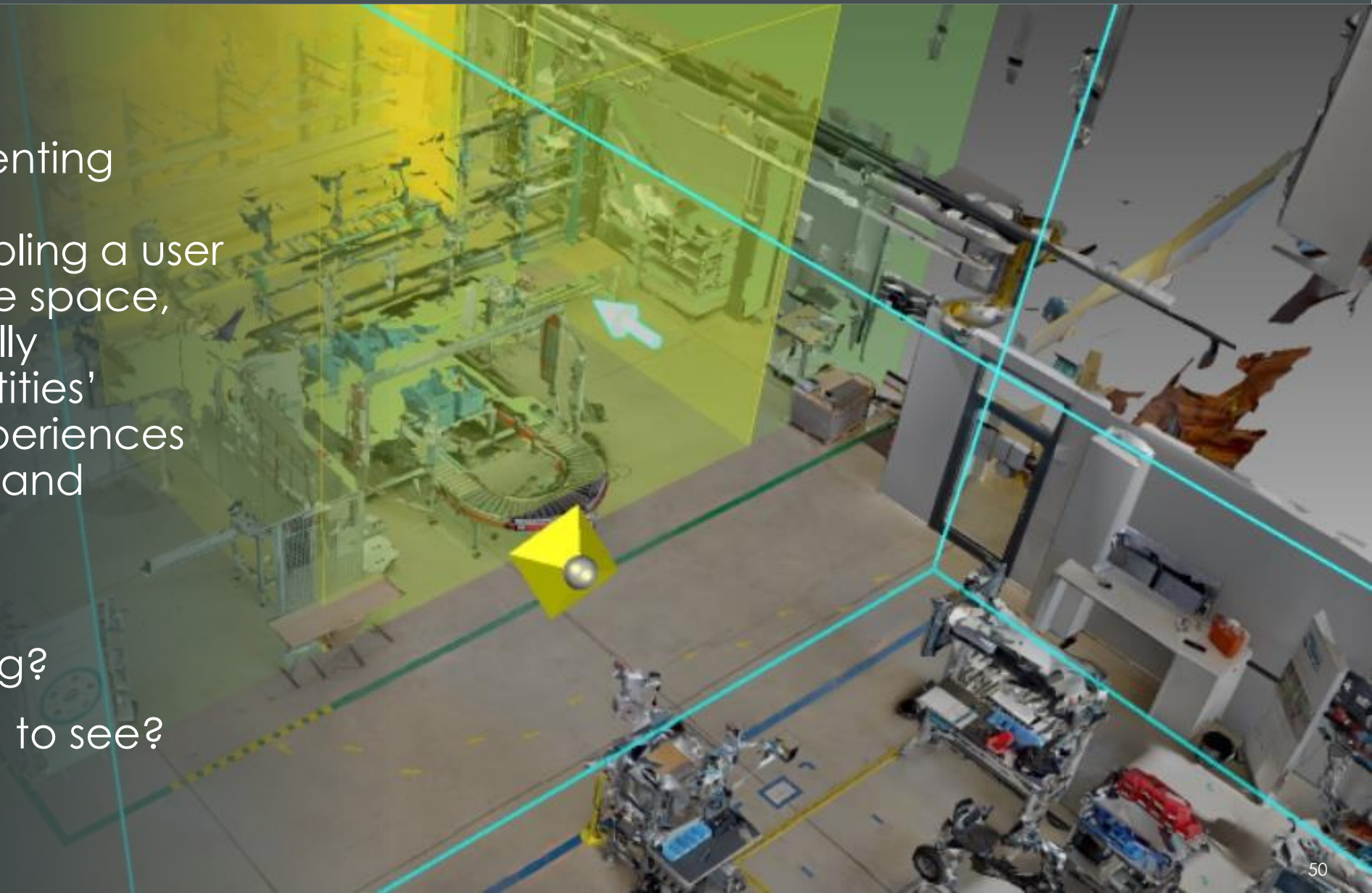
Step 5



LOCATION-BASED, DYNAMIC DELIVERY OF CONTENT FOR AUGMENTING LARGE SPACES

Will enable augmenting content in a large environment, enabling a user to walk into a large space, and be dynamically presented with entities' corresponding experiences based on context and location

- Where am I?
- What am I doing?
- What do I need to see?






30-2

Status:  Running

OEE: 100%

Next Action: None

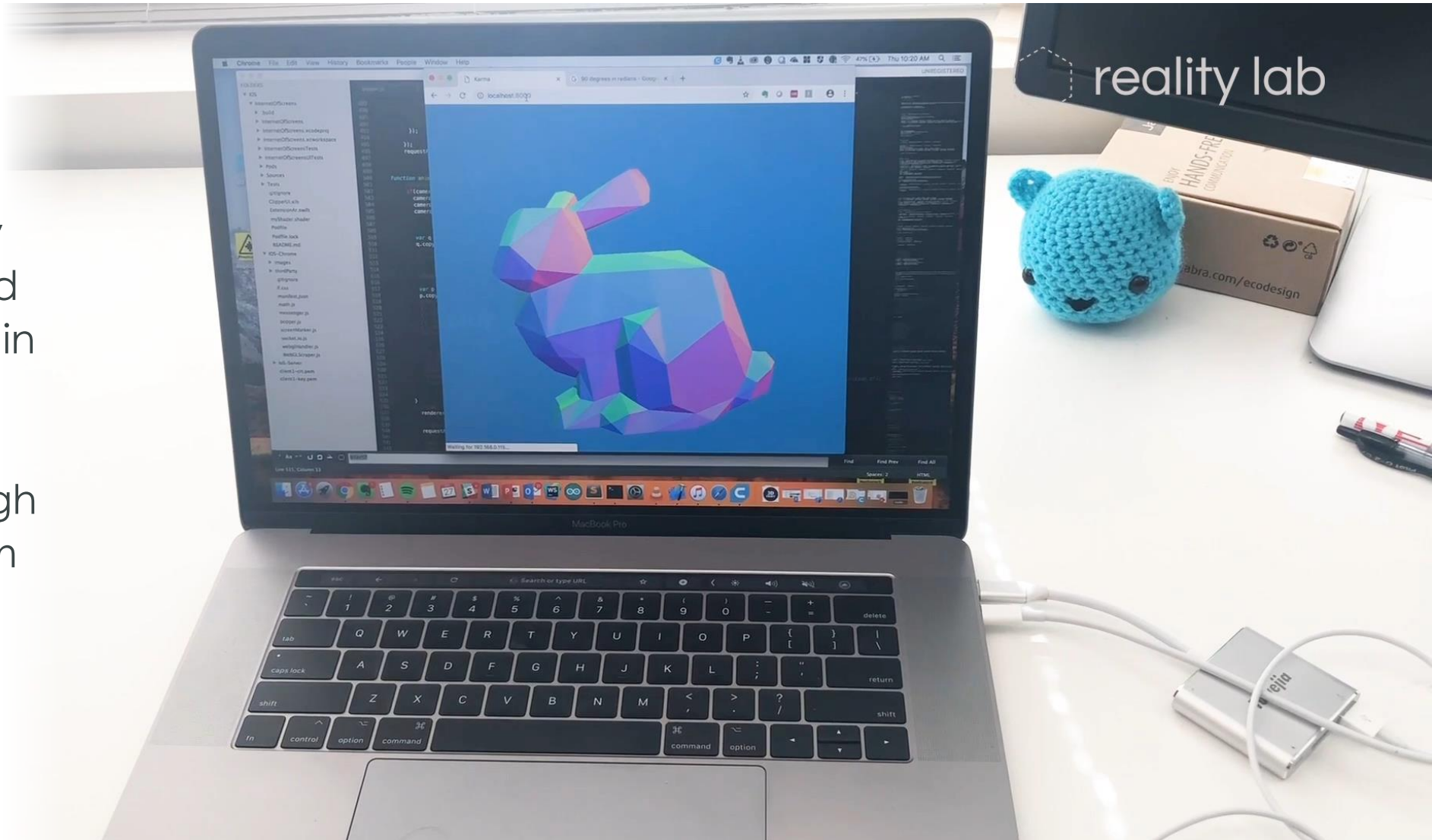
Stop Time: 10h44m20s

30-1
Status:  Running
OEE: 100%
Next Action: None
Stop Time: 10h44m20s

REALITY EDITOR

The **Reality Editor** is an open source AR platform, previously developed at MIT Media Lab, and is now used as a research and development tool within the PTC Reality Lab.

It provides breakthrough technology to program logic and interaction between connected devices in the context of the real world, using Augmented Reality.



FY'19 PRODUCT FOCUS – EVOLVE AND CONVERGE!



vuforia® engine

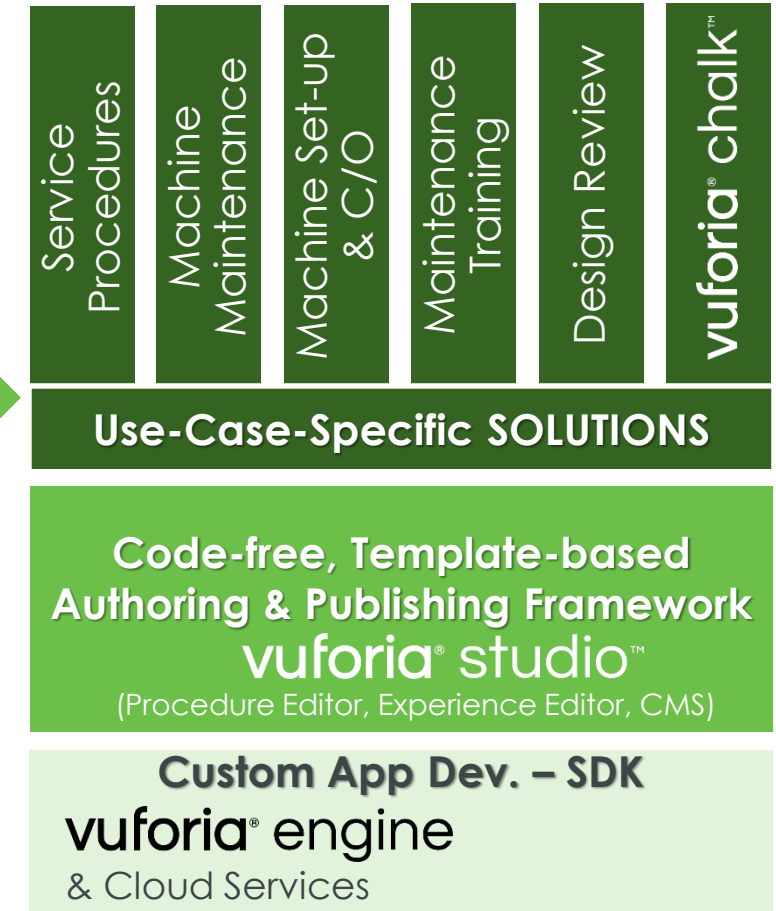
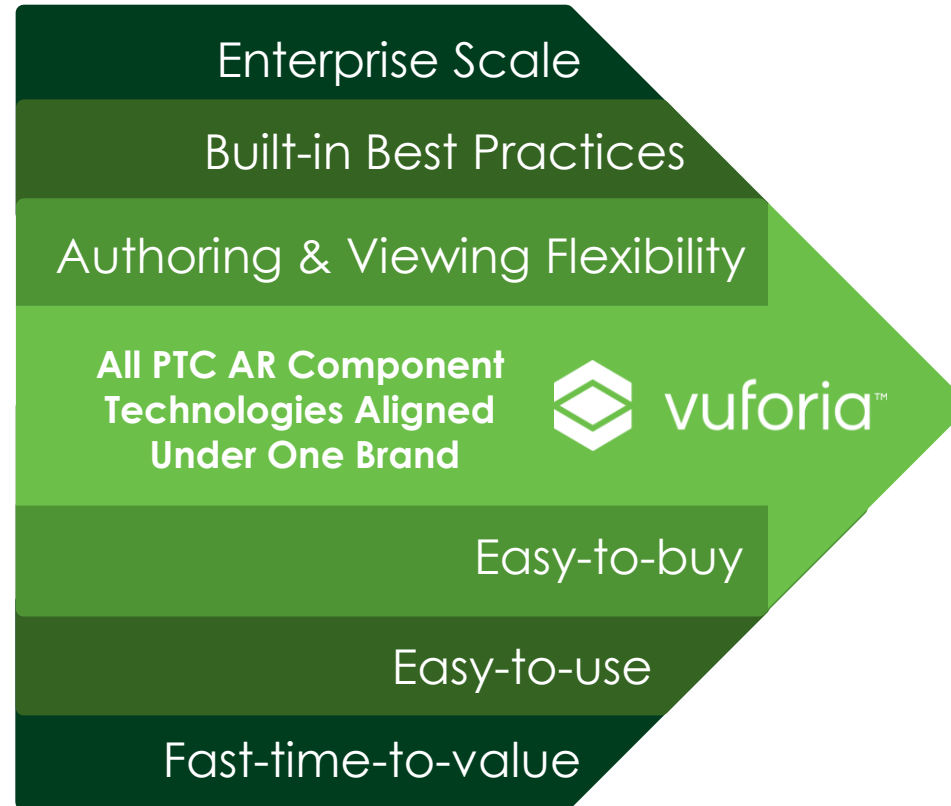
vuforia™ studio

vuforia™ view

vuforia® chalk™

creo® illustrate

**IN-SITU-CAPTURED,
LOCATION-BASED
CONTENT**



AR PRODUCT ROADMAP HIGHLIGHTS – COMING SOON!



Content Creation

- ❑ In-Situ Capturing
 - ❑ Easier authoring in work context
- ❑ Storytelling
 - ❑ Logic, loops, combination of new and existing content/media
- ❑ Seamless re-use of existing 3D content, and procedural guidance



Enterprise Readiness

- ❑ Scalability, Reuse, Automation
- ❑ Better with Microsoft Azure, HoloLens
- ❑ Secure & Privacy Controlled
- ❑ Manages role-based content
- ❑ Enterprise-friendly pricing & packaging



Content Delivery

- ❑ Delightful UX, “out-of-the-box”
- ❑ Cross-Platform Support, Device-agnostic
- ❑ Location-aware; enables Spatial Navigation
- ❑ Seamless Remote Expert Guidance
- ❑ Embeddable Viewer or Stand-alone App

MANUFACTURE



SERVICE



TRAIN



“Most companies are just getting started with AR, and most have few experts on staff. That’s where **partnering with experts is key, and one of the pioneering experts in the field is PTC.**”

Tom Mainelli, IDC

Whitepaper: How Augmented Reality Drives Real-World Gains in Services, Training, Sales & Marketing, and Manufacturing





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100+
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