# Manufacturing Beyond 2025

The Role of AR/VR in Creating Intelligent Environments for Knowledge Workers

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# Purpose & Flow (Inform/Share)

This presentation is intended to share some emerging technology & workforce trends that will shape our manufacturing environments of the future.

It also provides an insight into how XR (eXtended Reality) capabilities play an integral role in creating and delivering these modern, diverse, inclusive and boundaryless workspaces to our knowledge workers.
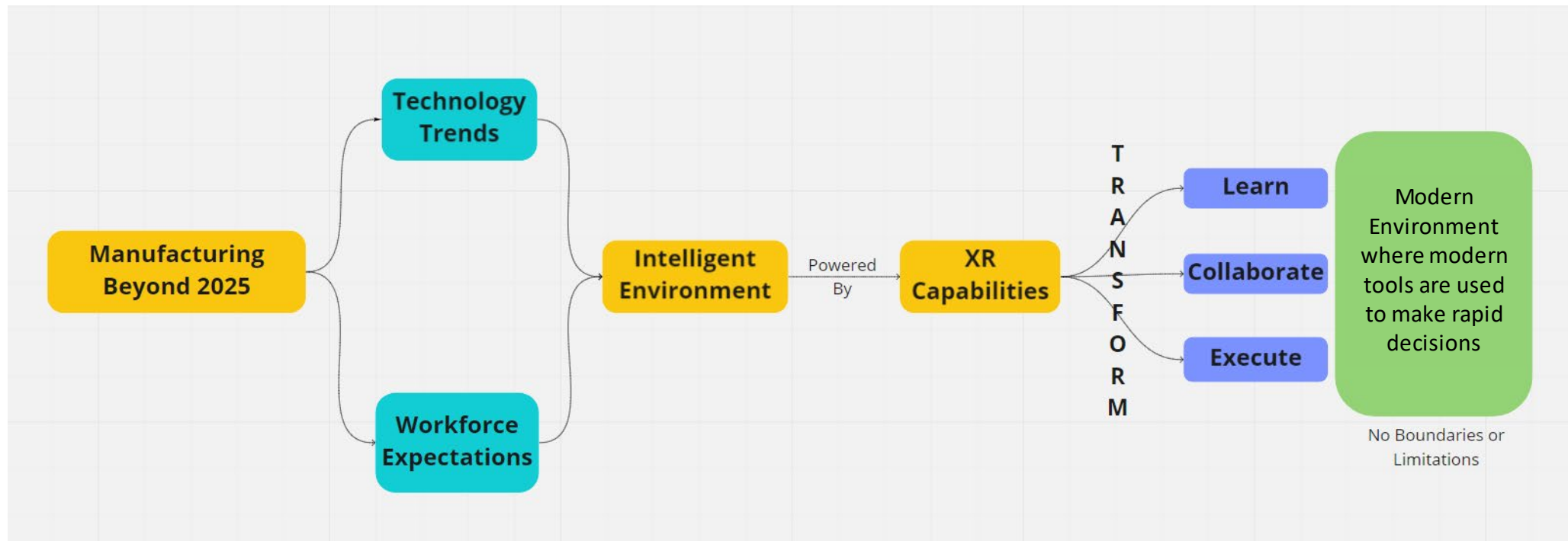
# Beyond 2025, Manufacturing will enter an Age of Instinct[1]

An Instinctive Enterprise continuously adapts and thrives. It is powered by augmented workforces & flexible factories

| Workforce | Manufacturing | Customers |
|---|---|---|
| Augmented | Nimble | Empowered |
| Diverse | Customizable | Very Aware |
| Flexible | Agile | Savvy |
| Nomadic | Responsible | |
| Savvy | Sustainable | |
| Inclusive | Cost Effective | |
| Empowered | Flexible | |
| Rapid Access | | |
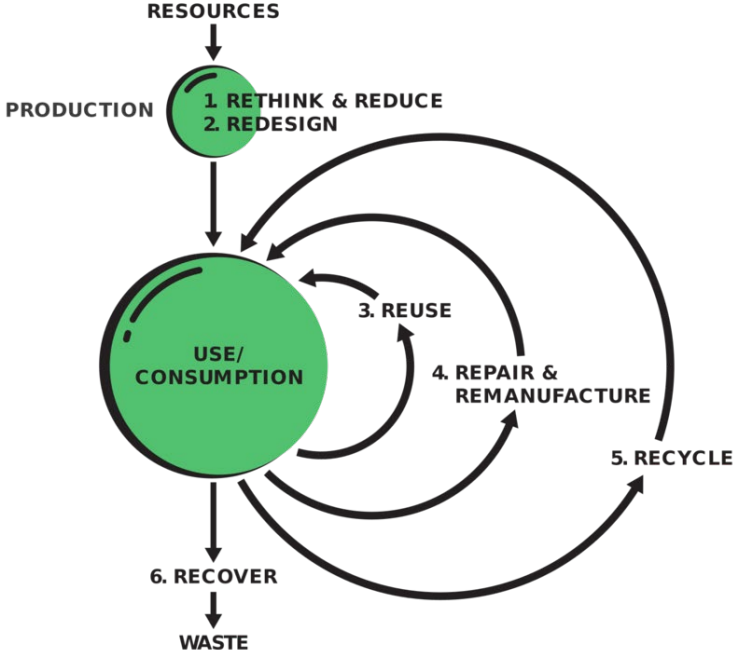


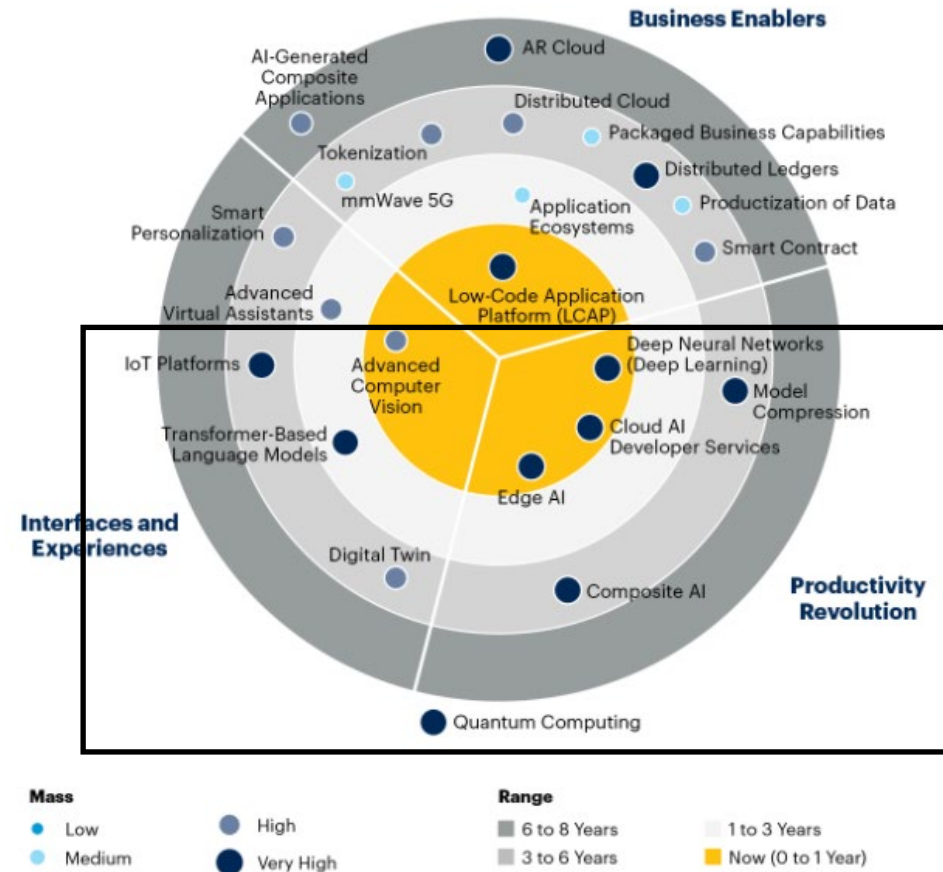Changing expectations of new generations, a circular economy and emerging technology trends will be the main drivers for change

# Emerging Technology Trends that will shape our manufacturing spaces
## – Heavily Influenced by Modeling & Simulation Tools





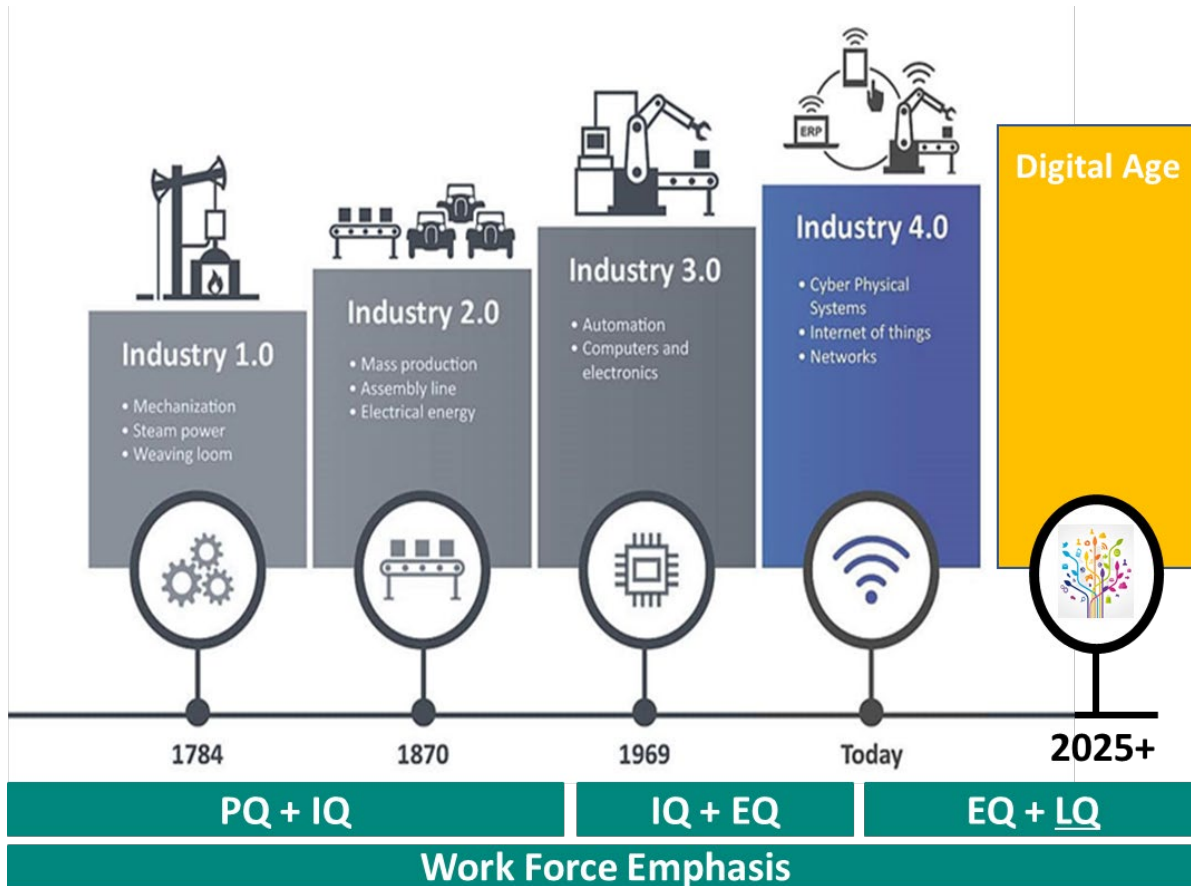Modeling & Simulation Trends

Images Source: Gartner 2021

# Changing workforce expectations will shape how we build our modern facilities



## Our knowledge workers will expect to work in "Intelligent Environments"

| | |
|---|---|
| **Work Style** | – Digital Nomads |
| **Org Reputation** | – Sustainable, Ethical, Socially Responsible |
| **Learning** | – Modern, Contextual, Experiential |
| **Digital** | – Highly Savvy |
| **Data** | – Data needs to pervasive with instant access |
| **Access** | – Just in time & contextual access to info |
| **Security** | – Data needs to be private and secure |
| **Integration** | – Expect seamless integration of all tools |

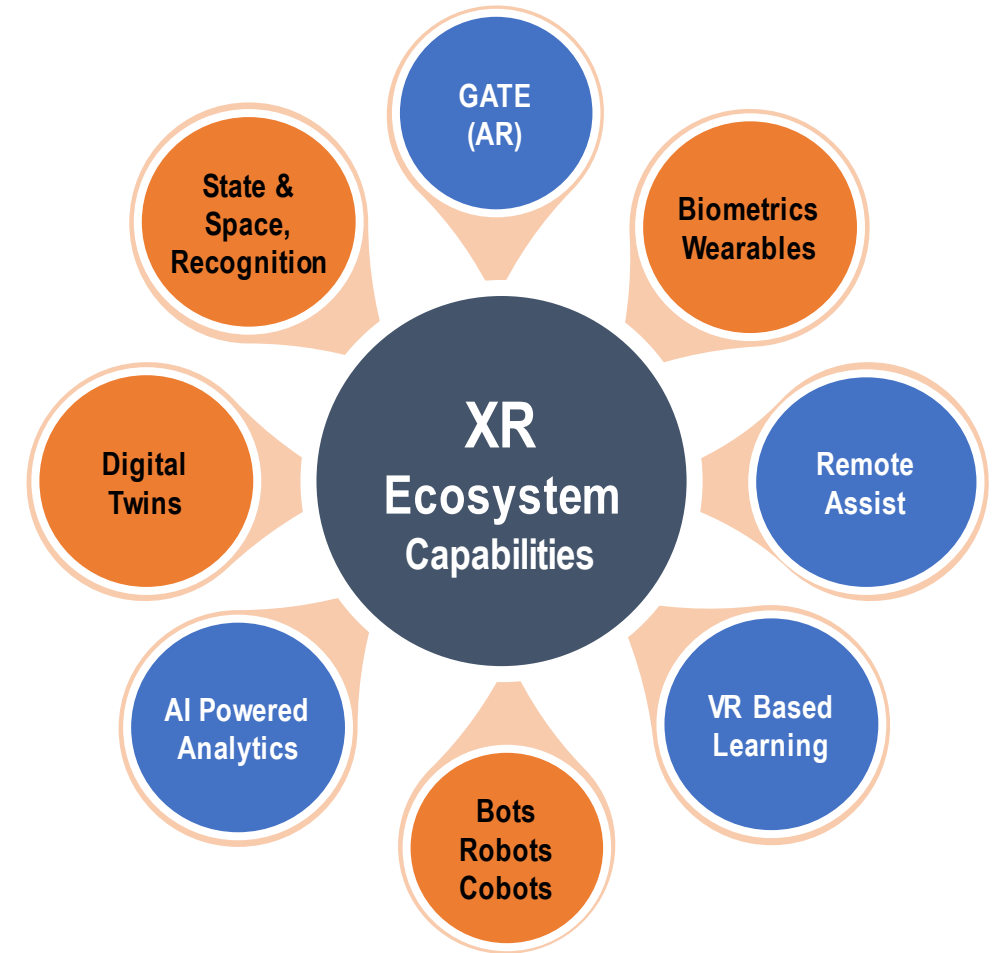P = physical     I = intellectual     E = emotional     L = learning

# Our Future Environments will need to be Intelligent.
## - And these intelligent environments will be Powered and Delivered by the XR ecosystem

An **Intelligent Environment** is
- Acutely aware
- Immediately responsive
- Seamlessly Integrated

In this environment, people technologies and equipment work in harmony and decisions are taken proactively or in real-time based on data & performance.
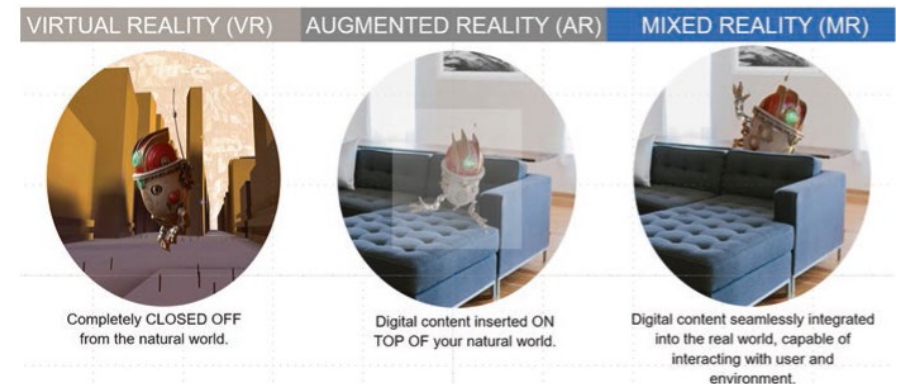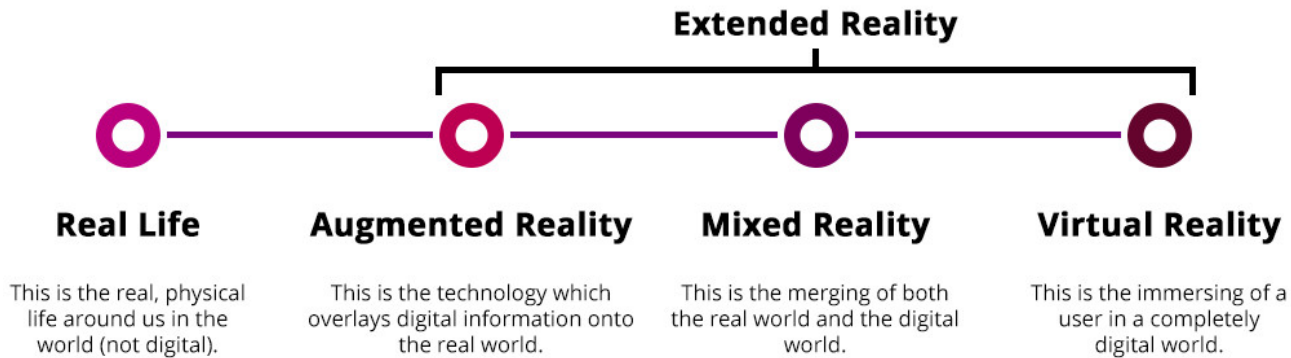


GATE (AR) · Biometrics Wearables · State & Space, Recognition · Remote Assist · Digital Twins · **XR Ecosystem Capabilities** · VR Based Learning · AI Powered Analytics · Bots Robots Cobots

# eXtended Reality (XR) – a quick recap

**Models & Simulations are foundational elements to XR**

**EXPERIENCE** real life scenarios in
100% virtual environment
Eg: Mars Rover Simulation, LOTO Simulation

**AUGMENT** and seamlessly
**INTERACT** with user and
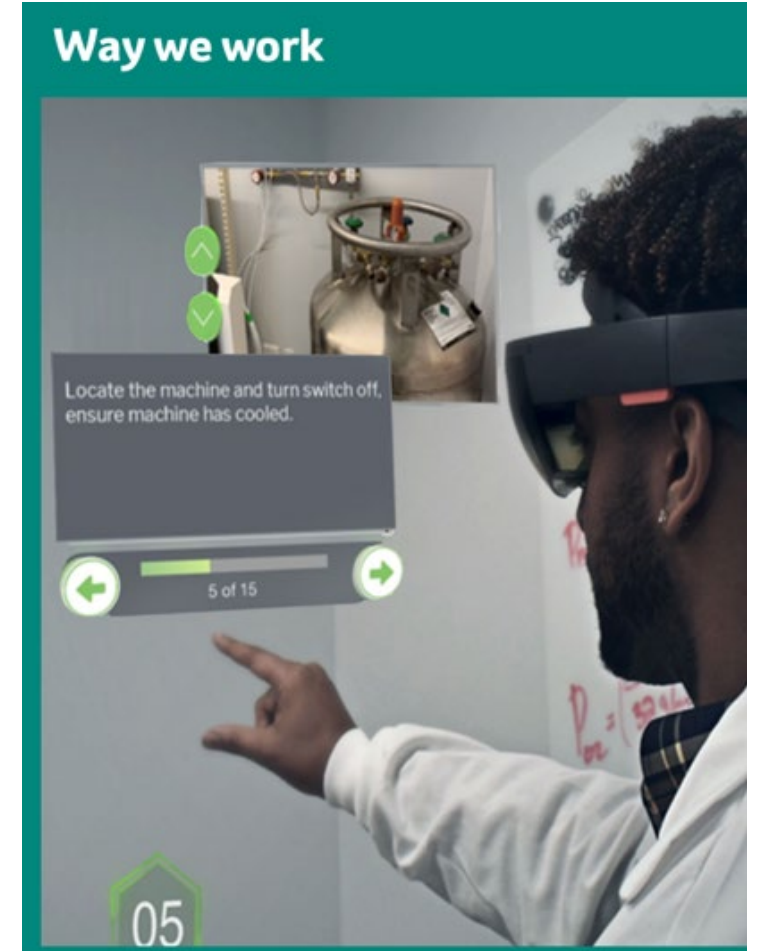environment in real world
(eq: Start/stop a pump in AR)
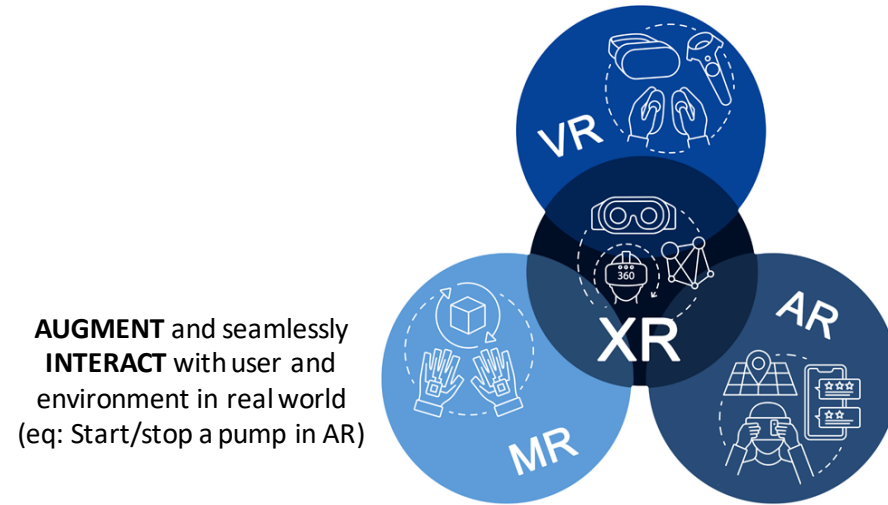
Add 3D models and content from
disparate sources on top of our real
world to **AUGMENT**
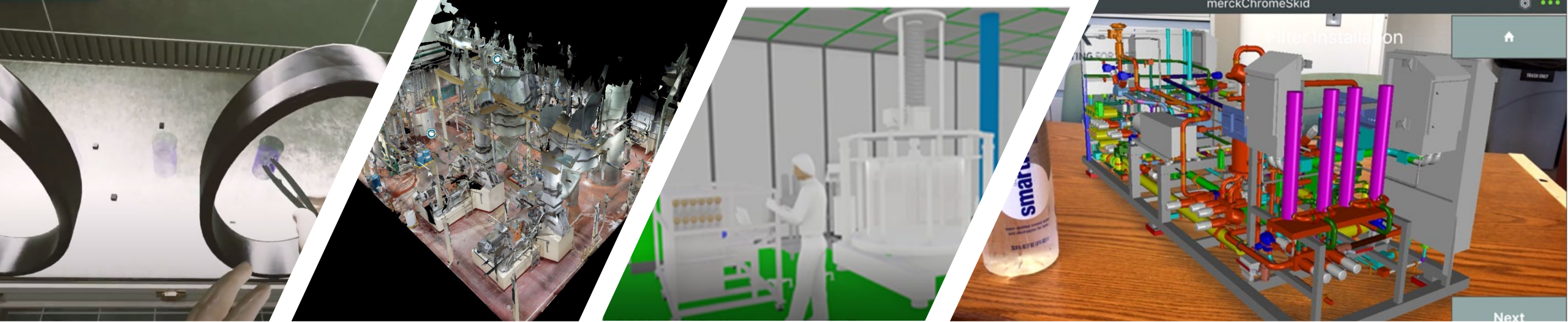it with contextual information
(eg: Maintenance on Pumps)

## Extended Reality

**Real Life**
This is the real, physical
life around us in the
world (not digital).

**Augmented Reality**
This is the technology which
overlays digital information onto
the real world.

**Mixed Reality**
This is the merging of both
the real world and the digital
world.

**Virtual Reality**
This is the immersing of a
user in a completely
digital world.

| VIRTUAL REALITY (VR) | AUGMENTED REALITY (AR) | MIXED REALITY (MR) |
|---|---|---|
| Completely CLOSED OFF from the natural world. | Digital content inserted ON TOP OF your natural world. | Digital content seamlessly integrated into the real world, capable of interacting with user and environment. |

# XR has an immense potential to transform the..



Way we collaborate

Way we learn

Way we work

Locate the machine and turn switch off, ensure machine has cooled.
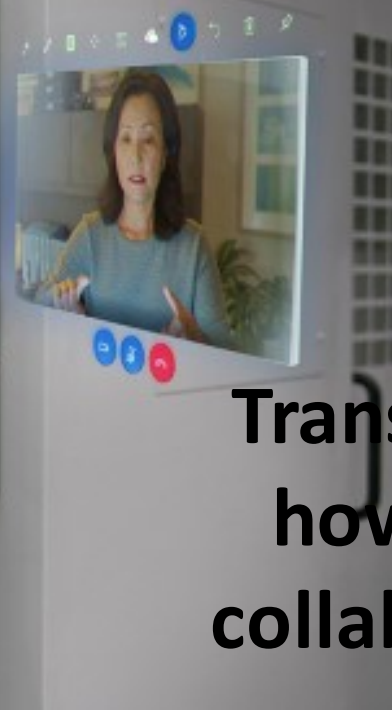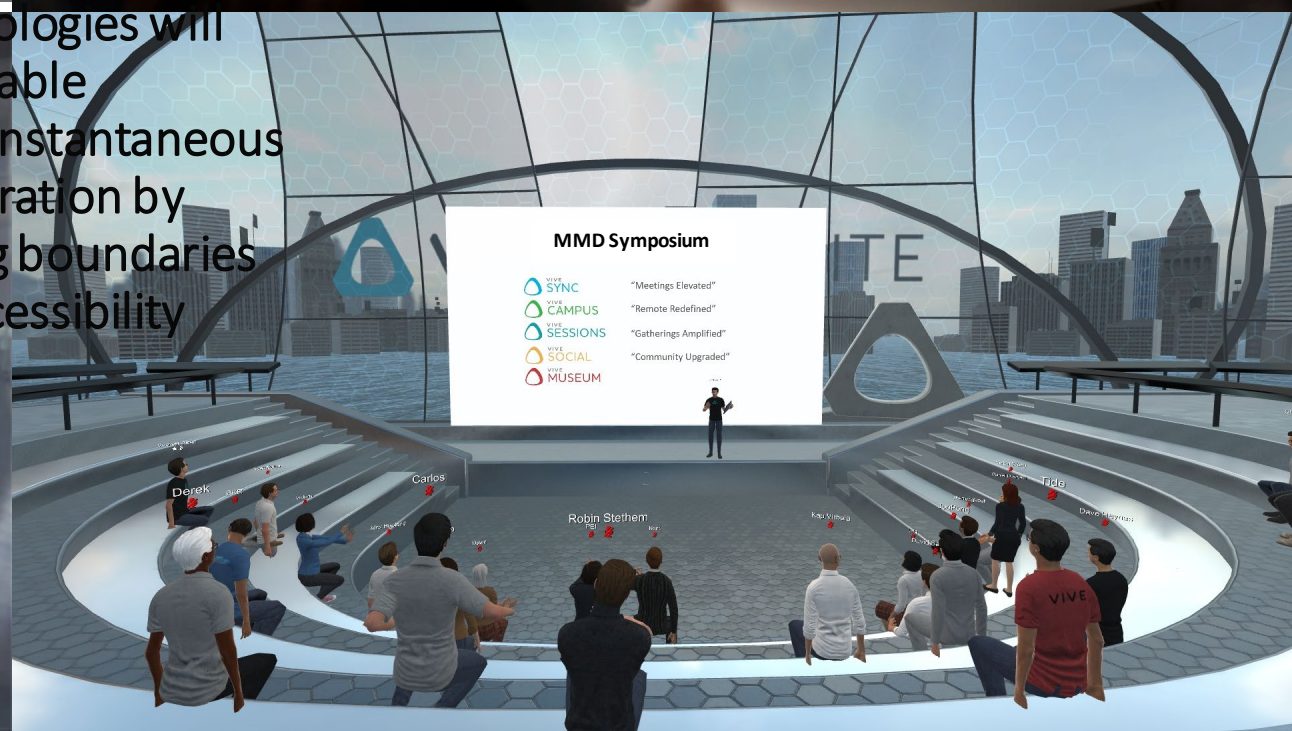
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## and our TOTAL EXPERIENCE

# Transform how we learn

XR technologies will enable inclusive and equitable learning environments where opportunities are endless, and everyone learns in one standard way
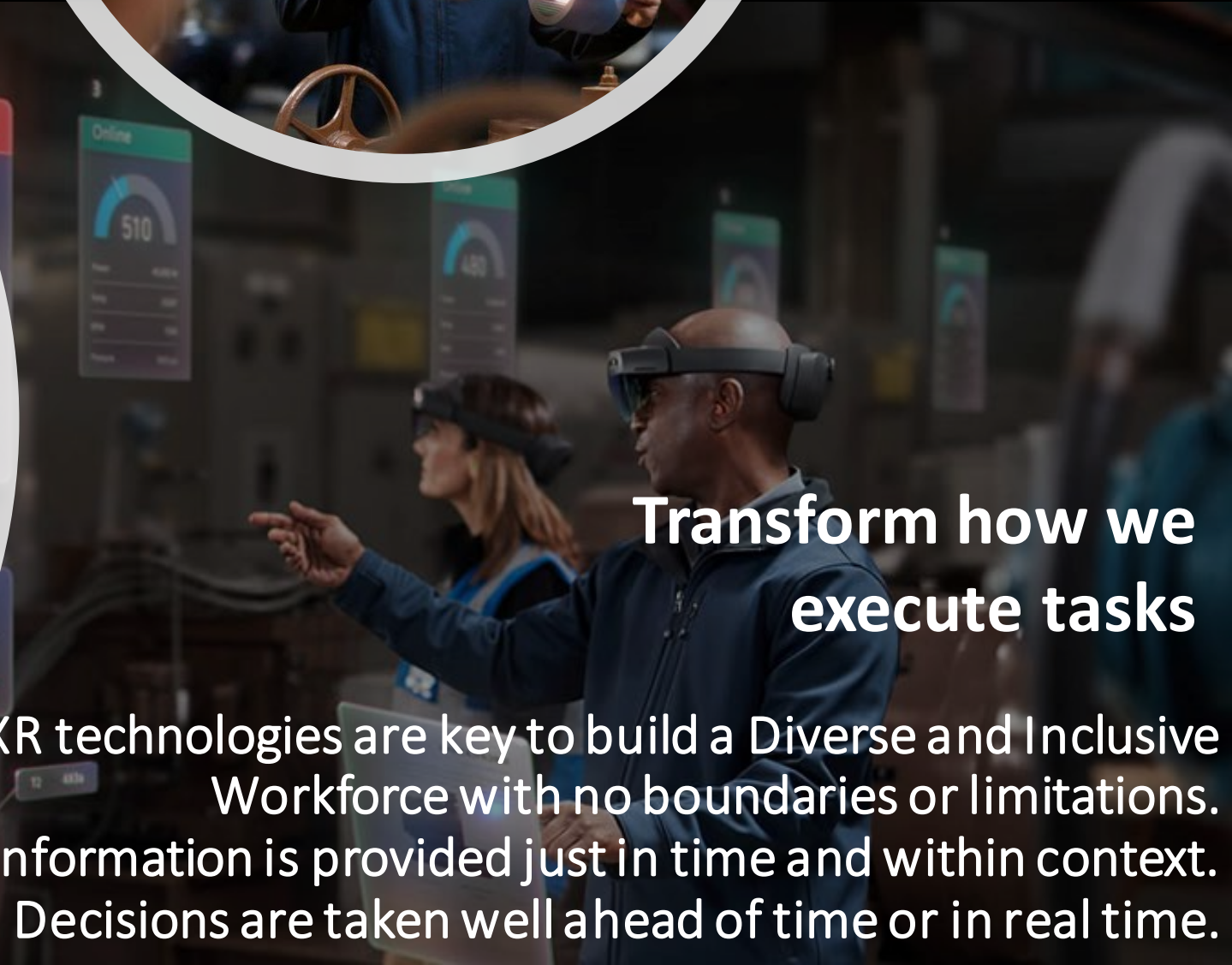
**Transform how we collaborate**

XR technologies will enable Inclusive & Instantaneous collaboration by eliminating boundaries and accessibility
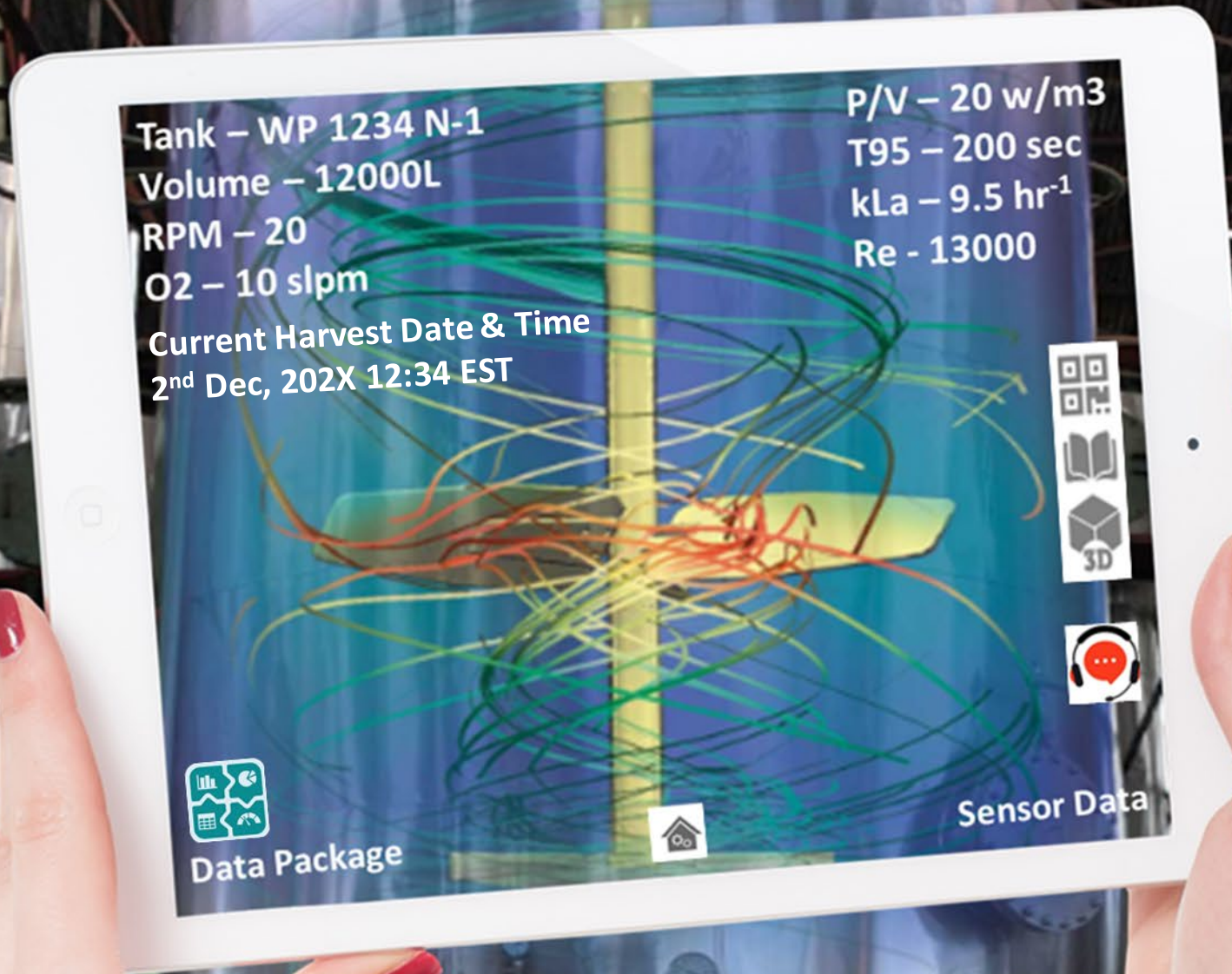
**Transform how we execute tasks**

XR technologies are key to build a Diverse and Inclusive Workforce with no boundaries or limitations. Information is provided just in time and within context. Decisions are taken well ahead of time or in real time.

# Transform our Total Work Experience

powered by seamless integration of several XR capabilities

Tank – WP 1234 N-1
Volume – 12000L
RPM – 20
O2 – 10 slpm

$P/V$ – 20 w/m3
T95 – 200 sec
kLa – 9.5 $hr^{-1}$
Re – 13000

Current Harvest Date & Time
2nd Dec, 202X 12:34 EST

QR Access on Devices & Role Dependent

Data Package

Sensor Data

Fictional Mockup Data

# At Merck, we are taking strides to transform how we Learn, Collaborate, Execute and Experience with XR - TODAY

## Remote Assist - Deployed (Collaborate)

- 100% adoption across all sites
- Multiple Millions in value realized (2yrs)
- Thousands of FTE hrs freed up from non-value-added travel time
- **5:1 ROI**

Enabled instantaneous collaboration and troubleshooting from anywhere in the world using smart glasses.

## Guided Augmented Task Execution - POV (Execute)

- Reduce Human Error by 50%
- Increase Right First Time by 90%
- Speed up time to competency by 50%

- Multiple successful POV's across all divisions and functions of Merck
- Very high value business case across training and execution
- Ready to be deployed and scaled (2022)

## VR – POCs (Learn)

- Use cases in Maintenance (2021)
- 360 Tours of shop floors (2021)
- Use cases for aseptic handling inside Isolators (2022)
- Use cases in facility design (2021-22)

## Devices – POVs/Deploy (Access)

IPADs – Deployed
Hololens – POVs for GATE & RA
Realwear – Deployed for RA
Hands Free Bands (access control) – POVs
VR Headsets – Evaluation via POCs

## Space/State Recognition – POC's (Experience)

- AI based image recognition – (2021-22)
- Spatial Digital Twins – (2021-22)
- Video/Image Recognition –(2021-22)

## Augmented Reality - POCs (Execute)

- AR for Maintenance activities (2022)
- AR for Change Over (2021)
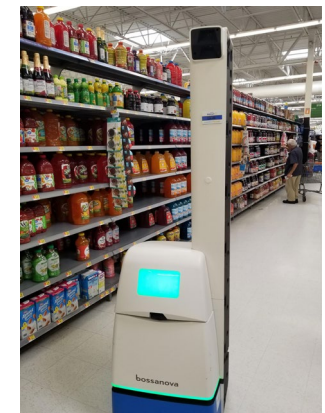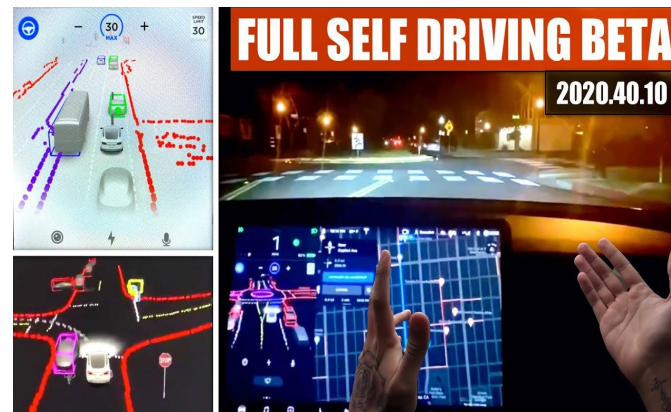- AR for Intelligent Environments (2022)

# Future

It is not a distant dream..

It is already here all around us!

**THANK YOU**



AUTOMATED WAREHOUSE ROBOT





amazon go

NO LINES. NO CHECKOUT. (NO, SERIOUSLY.)

amazon go



FULL SELF DRIVING BETA

2020.40.10

# It takes some of us to predict the future
# It takes ALL of us to build it…

Douglas Arnold
Ajit Kanattil
Brant Hoekstra
Jaraslov Kazmir
Shilpa Adavelli
Terri Sarisky

David O Connell
Harmik Begi
Barry Mulcahy
Sarath Moses
PK Yagneswaran

Alone we can do so little; together we can do so much.

— Helen Keller —

AZ QUOTES

Digital Champions
Site & Business Teams
External vendors/partners

…and many others