Microsoft

hypothesis

Mixed Reality Intelligence

Healthcare Edition

December 2020

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Background

As companies across the world begin employing immersive technologies to drive efficiencies, Mixed Reality is poised to change the way businesses operate. Mixed Reality blends the digital and physical world by overlaying 3D digital objects onto the user's physical world, offering a way for users to interact organically using head-mounted devices (HMDs). Located at the center of the virtuality continuum, the capabilities of Mixed Reality render it uniquely positioned to transform the workplace as we know it.

Microsoft has been at the forefront of the immersive technology market and a trailblazer in Mixed Reality, innovating in both hardware and software to offer cross-platform Mixed Reality solutions. With the introduction of HoloLens, the first untethered Mixed Reality headset designed with business use cases in mind, Microsoft established itself as a leader in the Mixed Reality space and validated the enterprise value of this nascent industry by partnering with prominent entities in contracts worth up to half a billion dollars.

In October 2020, Microsoft and Hypothesis embarked on an initiative to hear from IT and Business Decision Makers across three countries with the goal of developing a deeper understanding of how Mixed Reality is being utilized across three key industries: manufacturing, retail, and healthcare. This paper deep dives into how healthcare organizations are using and considering Mixed Reality technologies. While the primary data collected are quantitative, this report also illuminates customer stories that bring said data to life, providing a comprehensive picture of Mixed Reality use in the market today.

Furthermore, this report also aims to uncover the ways in which Mixed Reality may evolve in the future.

Methodology

Microsoft commissioned Hypothesis Group, an insights, design, and strategy agency, to execute the Mixed Reality Intelligence research.

The Mixed Reality Intelligence Research occurred in October 2020, when a 15-minute online survey was conducted with over 700 decision makers involved in mixed reality decisions at mid-market and enterprise companies from a range of manufacturing, healthcare, and retail companies across the US, Germany, and Japan.

In addition, the research deep dives into customer stories from interviews between Microsoft and mixed reality decision makers at enterprise companies around the world that use HoloLens 2.

Healthcare Customer Stories

Case Western Reserve University EST. 1826 | NHS Imperial College Healthcare NHS Trust | MEDIVIS

Who We Talked To

October 2020

Final Audience

Things To Know About Mixed Reality

1 **Within healthcare, 3-in-4 organizations are currently using Mixed Reality solutions via HMDs (though lower than in manufacturing and retail). In the next 12-24 months, all in healthcare expect to invest as much in the technology as they do today, or even more. Among those currently using Mixed Reality or considering it for the future, the technology is critical to organizational success (99% agreement).**

2 **Healthcare organizations are held back from using Mixed Reality by complex regulatory processes and the extensive use of legacy systems that permeate the industry, both for current and prospective users. Budget concerns are also a top inhibitor among prospective users, but once the technology is proven among current users, the cost is less of a concern.**

3 **Mixed Reality is used most in healthcare for Training & Simulation solutions to prepare and educate healthcare workers, including medical students who could be potential users over their entire career. Using Mixed Reality for Remote Assistance and Contextual Data Overlay is not as common, but both have strong growth potential in the next 12 months.**

4 **On average, the majority (about 2-in-3) of healthcare organizations that use Mixed Reality estimate a return of 40% or more from their investments across Training & Simulation, Remote Assistance, and Contextual Data Overlay applications. Customer success stories from Case Western Reserve University, Imperial College Healthcare, and Medivis demonstrate how HoloLens 2 solutions meet and exceed these industry expectations.**

Mixed Reality in **Healthcare**

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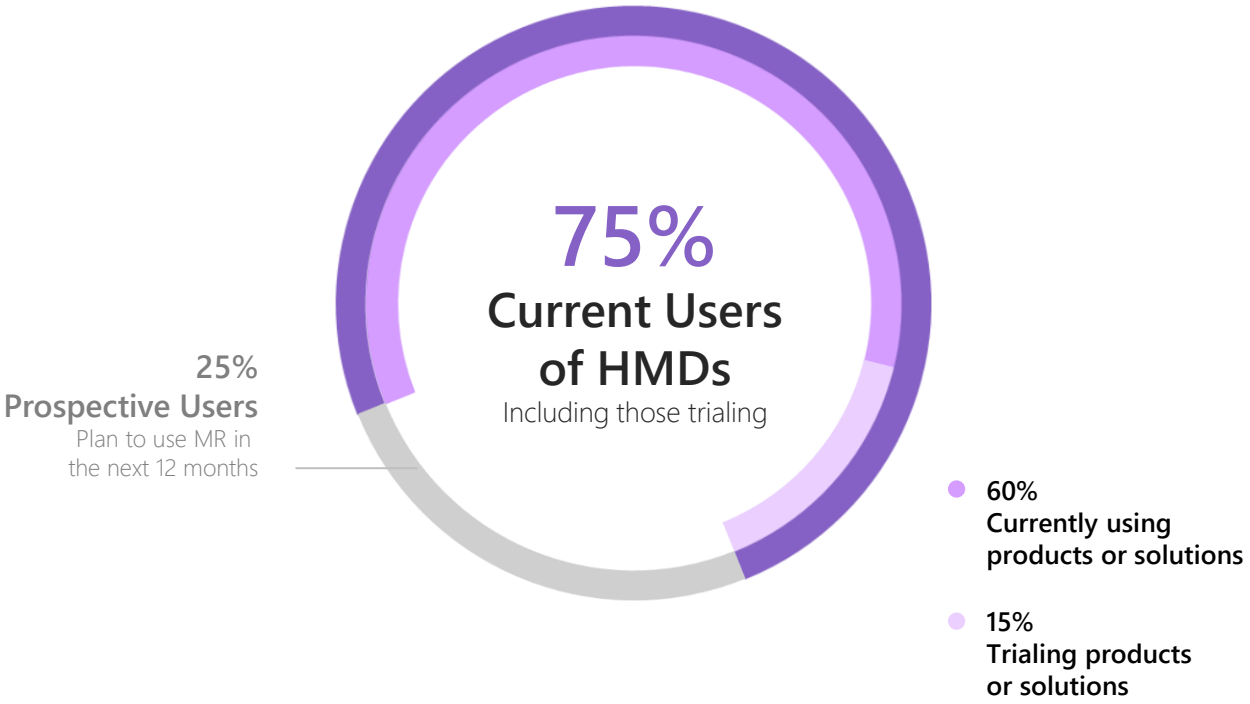
The Big Picture

Compared to Manufacturing and Retail, Mixed Reality usage is notably lower in the Healthcare sector. That said, 3-in-4 Healthcare organizations surveyed are currently using Mixed Reality solutions, and a majority (60%) have committed to adoption beyond the trial phase. Most Mixed Reality users in Healthcare find themselves in relatively early stages of implementation, with 62% of current users having employed the technology for less than two years. Across the three markets examined, usage skews akin to manufacturing: German Healthcare organizations boast the highest number of current users (84%) and Japanese organizations the least (67%); U.S. organizations align with the overall average (75%). **(Exhibit 1)**

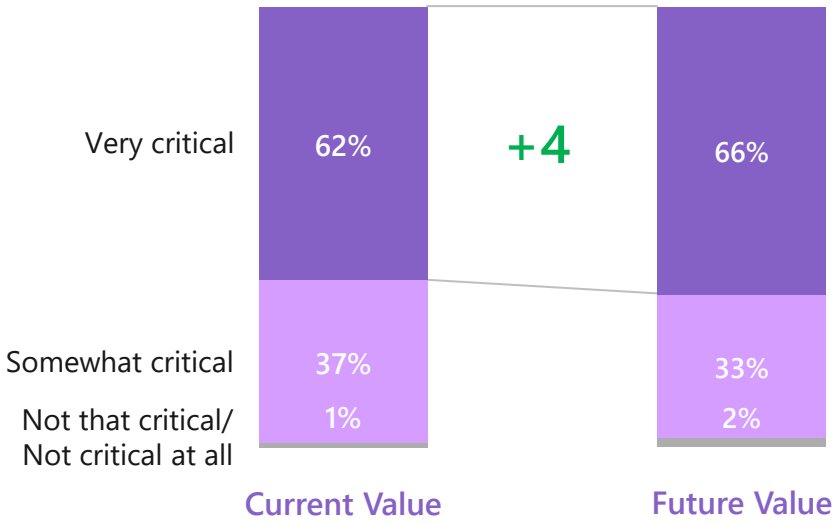
EXHIBIT 1. CURRENT VS. PROSPECTIVE USERS OF MIXED REALITY



Among Healthcare organizations currently using Mixed Reality, there is widespread agreement that the technology is crucial to their success. Furthermore, while Mixed Reality is at present less ubiquitous in Healthcare compared to other industries, organizations are nevertheless confident that its value will increase over time. This prediction about the future value of Mixed Reality solutions is reflected in organizations' investment plans: current users are committed to Mixed Reality technologies and will continue to invest the same or more in coming years; fewer than 1% plan to invest less than they currently do. Indeed, for Healthcare organizations to continue their commitment to offering the best healthcare services, their practices must integrate the most current technological capabilities available. "There are so many ways Mixed Reality will be used in the future in Healthcare," explains a current Mixed Reality IT Decision Maker and healthcare provider. "We will fall behind if we don't continue to develop our use of this technology."

Among current users, Mixed Reality usage in the next 12 months will be highest among organizations with more than 5,000 employees, with growth among these very large enterprises projected at nearly 100%. That said, the smallest Healthcare providers surveyed (those with between 500 and 1,000 employees) anticipate a growth rate almost double that of the medium-sized enterprises, suggesting that--even for companies with less disposable income--Mixed Reality solutions are seen as a viable growth strategy to justify the price tag. **(Exhibit 2)**

EXHIBIT 2. MIXED REALITY CURRENT VS. FUTURE VALUE



Mixed Reality Barriers

Both prospective and current users in Healthcare cite implementation challenges such as issues with timing/deployment and software incompatibilities as top barriers for using Mixed Reality. Compliance issues also surface as a salient barrier for users in Healthcare, an industry with extensive use of legacy systems and complex regulatory processes. Logically, the Healthcare industry is subject to substantial regulation, and this barrier likely accounts for the underutilization of Mixed Reality solutions in this industry despite its high valuation among IT and Business Decision Makers. **(Exhibits 3 & 4)**

Prospective Mixed Reality users in Healthcare also cite the imperative to store data in the cloud as a chief concern. Cyberattacks on hospitals, clinics and medical complexes are on the rise, with hackers threatening to hold Personal Health Information (PHI) hostage in exchange for ransom payments. Because cloud storage comes with additional security vulnerabilities, this must be an important consideration for Healthcare organizations considering trial and/or adoption of Mixed Reality, both out of caution for their patients' safety as well as their own liability. Across the three markets, German Healthcare Mixed Reality users are the most inhibited by security and liability concerns. **(Exhibits 3 & 4)**

EXHIBIT 3. BARRIERS TO USING MIXED REALITY MORE (TOP 5)

Top 5 Barriers For Current Users	
Issues with timing and deployment	26%
Too complex to integrate with legacy systems	25%
Still in the process of implementing current MR solutions	22%
Too many compliance/ regulatory challenges	22%
Want to work out existing MR challenges	22%

EXHIBIT 4. BARRIERS TO CURRENTLY USING MIXED REALITY (TOP 5)

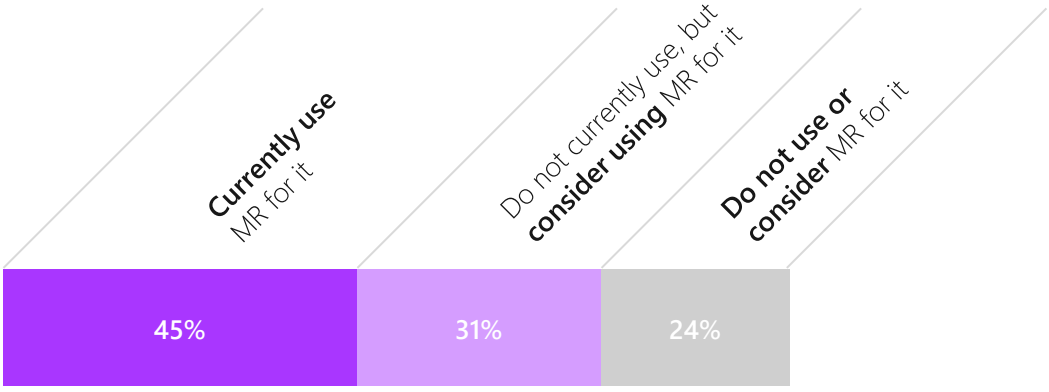
Top 5 Barriers For Prospective Users	
Too complex to integrate with legacy systems	26%
Too many compliance/regulatory challenges	26%
Incompatible with existing software solutions	24%
Don't have enough budget	19%
Concerned about storing data in a public cloud	18%

Training and Simulation

Deep Dive into CASE WESTERN RESERVE UNIVERSITY EST. 1826

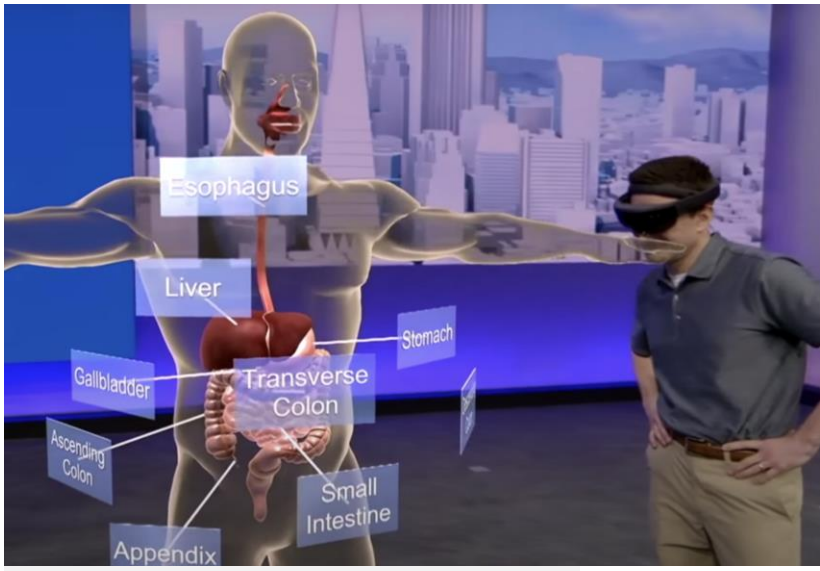
In training new employees and practitioners, Healthcare providers are faced with a unique challenge: the work itself is hands-on, but any training that takes place in an authentic environment runs the risk of adversely impacting patient care. Mixed Reality, consequently, provides an ideal solution for Healthcare organizations, who can use the technology to create holographic simulations of medical scenarios to train and educate healthcare workers. Implementing Training and Simulation through Mixed Reality allows workers to learn how to examine, diagnose, and treat patients, and practice technical surgical skills in a low-risk simulated environment that is as close to real-life as possible but devoid of real-life consequences. Nearly half of Healthcare organizations currently utilize Mixed Reality for Training and Simulation, and another 31% are currently considering adoption. (**Exhibit 5**) Case Western Reserve University in Cleveland, Ohio is a vanguard of this use case.

EXHIBIT 5. USAGE VS. CONSIDERATION OF MIXED REALITY FOR TRAINING AND SIMULATION



USING HOLOLENS 2 FOR TRAINING & SIMULATION

The Medical Department at Case Western Reserve University has identified an opportunity to teach anatomy more effectively and provide students with hands-on training in a low-risk environment, without putting any patients at risk. Case Western is using their HoloAnatomy software on HoloLens 2 to teach students anatomy in a highly visual environment where they can practice skills in interactive, 3D scenarios. While originally designed to supplement traditional classroom training, this Mixed Reality use case has taken on a more prominent role during the COVID-19 pandemic, allowing medical students to complete the first-ever remote-only HoloAnatomy course. With survey data published by the American Medical Association indicating that 81% of students said that HoloAnatomy sessions were as good as or better than in-person instruction, Radiology Professor Mark Griswold of the Case Western Reserve University School of Medicine argues that Mixed Reality "ha[s] global implications for how education is delivered."



> *"[With HoloLens 2] Students are learning at the same level or better, they are doing it faster and they are retaining knowledge better. That's dream stuff, as a teacher."*

Mark Griswold
Professor, Department of Radiology
Case Western Reserve University

While a majority of Healthcare organizations have only recently implemented Mixed Reality for this use case, the results thus far are encouraging: more than two-thirds of current users estimate an ROI of 40% or higher and an average improvement of 48% in knowledge retention , the most desirable outcome for this use case . The potential for Mixed Reality to improve knowledge retention is exemplified by *Case Western*, whose medical students using HoloLens 2 and HoloAnatomy retained 120% more knowledge over the course of a year as compared to their peers who did not use the technology, and saw a 50% improvement in grades compared to traditional textbook learning. These outcomes suggest that the ability to see and interact with 3D images for anatomy classes helps students not only learn, but deeply internalize the knowledge. With undeniable success in learning and performance outcomes, *Case Western* plans to implement HoloLens teaching solutions across various other departments.

USING HOLOLENS 2 FOR TRAINING & SIMULATION

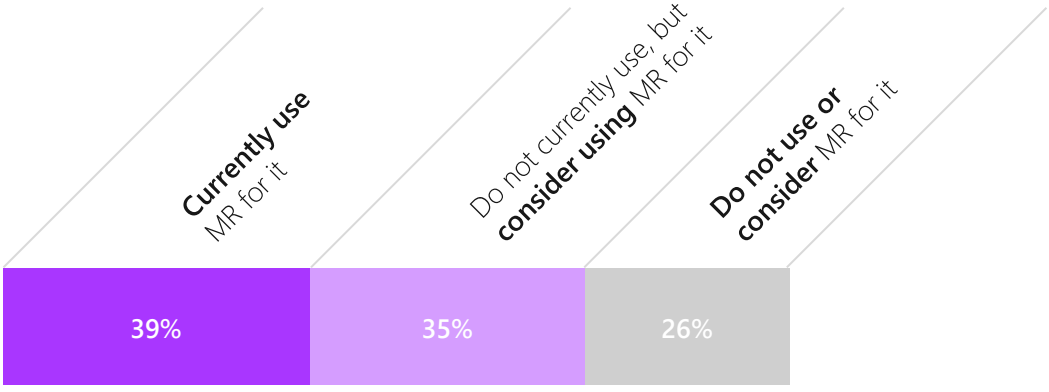
Remote Assistance

Deep Dive into NHS Imperial College Healthcare NHS Trust

The Healthcare industry has leveraged Mixed Reality solutions to connect practitioners in ways that were previously unimaginable. Mixed Reality for Remote Assistance allows healthcare workers to stream real, 3D videos of the patients they are treating to remote colleagues or experts, and allows doctors to share knowledge and expertise, and deliver care without having to be in the same room--or even the same hospital--as the patient. Nearly 2-in-5 Healthcare organizations currently use Mixed Reality for this use case.
(Exhibit 6)

Imperial College Healthcare has become one of its most visible proponents during the COVID-19 pandemic of using Remote Assistance. When the COVID-19 pandemic brought an overwhelming volume of highly-contagious patients into their hospital, Imperial College Healthcare was faced with an unprecedented challenge to keep its physicians safe while providing healthcare for COVID-19 patients. The hospital decided to adopt Dynamics 365 Remote Assist with HoloLens 2, which transmits a secure live video feed to a remote location in the hospital, allowing healthcare teams to see everything a doctor treating a COVID-19 patient in person can see. By implementing this creative solution, Imperial has been able to provide the best possible care for an increasing number of COVID-19 patients while reducing its physicians' exposure to the virus.

EXHIBIT 6. USAGE VS. CONSIDERATION OF MIXED REALITY FOR REMOTE ASSISTANCE



USING HOLOLENS 2 FOR REMOTE ASSISTANCE

Approximately two-thirds of current users estimate an ROI of 40% or higher when using Mixed Reality for Remote Assistance, and this optimism is borne out in the Imperial College Healthcare case: Remote Assist allowed the hospital to decrease exposure to COVID-19 patients by as much as 83% while simultaneously ensuring that each patient received the same quality of care and expertise, regardless of who was--or wasn't--in the room. In addition to the dramatic increase in employee safety, the implementation of Remote Assist on HoloLens 2 has driven other positive outcomes at Imperial. Most notably, it significantly reduced their consumption of Personal Protective Equipment (PPE) during a critical time in which PPE was extremely limited.

> *"We're now looking into other areas where we can use HoloLens 2 because it is improving healthcare without removing the human; you still have a doctor next to your bed, treating you."*
>
> Jim Kinross
> Senior Lecturer
> Imperial College Healthcare

While the pandemic was the impetus for integrating Mixed Reality for Remote Assistance into Imperial College Healthcare's protocol, this use case promises to revolutionize the Healthcare system well beyond the availability of a COVID-19 vaccine. "COVID-19 will change everything forever in terms of the way we work and how we work," explains James Kinross, Senior Lecturer at Imperial. "I can see the point where these sorts of tools will be the norm." Indeed, Remote Assistance may well be the solution the Healthcare industry has been looking for to address other systemic issues, such as the dearth of medical experts in rural areas of the United States.

USING HOLOLENS 2 FOR REMOTE ASSISTANCE

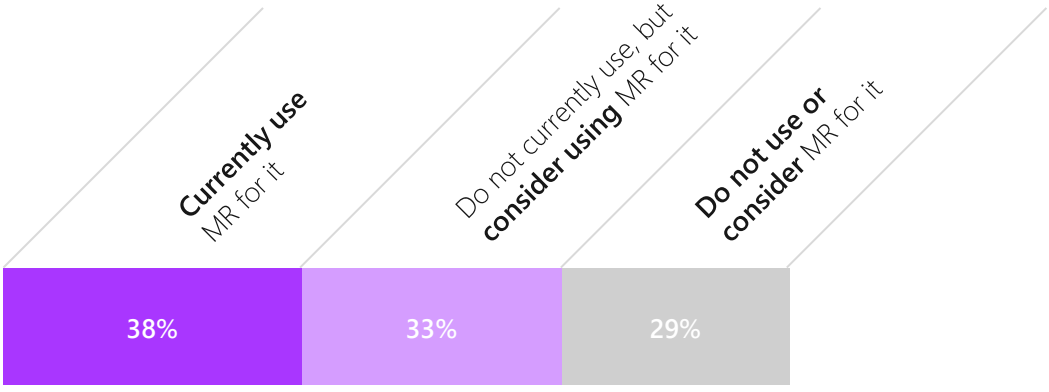
Contextual Data Overlay

Deep Dive into MEDIVIS

Beyond changing the way healthcare providers interact with and treat patients, Mixed Reality has the potential to transform the way doctors perform surgery. With Contextual Data Overlay, surgeons can register a virtual overlay of medical imaging (MR or CT scan) in patients to guide diagnosis or surgical navigation. They can use hand motions to interact with and manipulate images to visualize surgical scenarios and make faster, more informed decisions during surgical operations. Nearly 2-in-5 Healthcare organizations currently use Mixed Reality for Contextual Data Overlay. (**Exhibit 7**)

At the forefront of this use case is surgical AR company Medivis, which builds augmented reality data integration and visualization tools for surgeons. Invasive operations are fraught with preventable mistakes, as reliance on 2D imaging (CT, MRI) for surgical procedures leaves the door open to potential error. Medivis had been searching for a superior visualization technology to improve surgical accuracy when they decided to partner with Microsoft to develop a Mixed Reality surgical planning product, SurgicalAR for HoloLens 2. This custom Contextual Data Overlay is designed to empower surgeons and clinicians to maximize surgical accuracy and deliver better, safer patient outcomes.

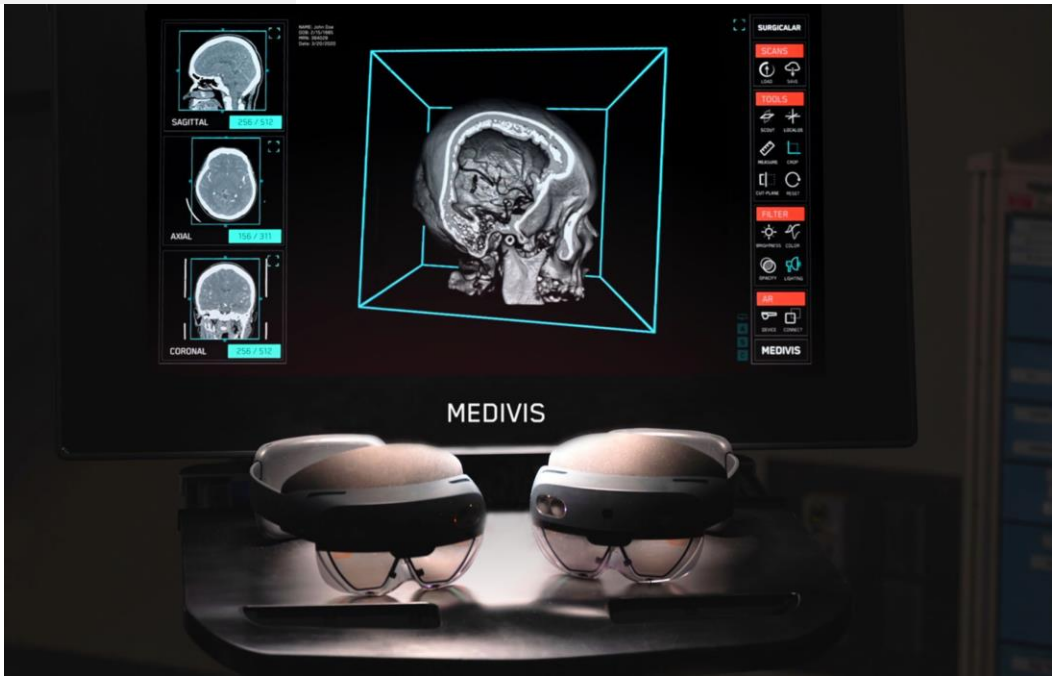
EXHIBIT 7. USAGE VS. CONSIDERATION OF MIXED REALITY FOR CONTEXTUAL DATA OVERLAY



"It excites us when we can do these routine procedures in an inherently superior way, so we can get our patients out of the operating room and safely back to their families."

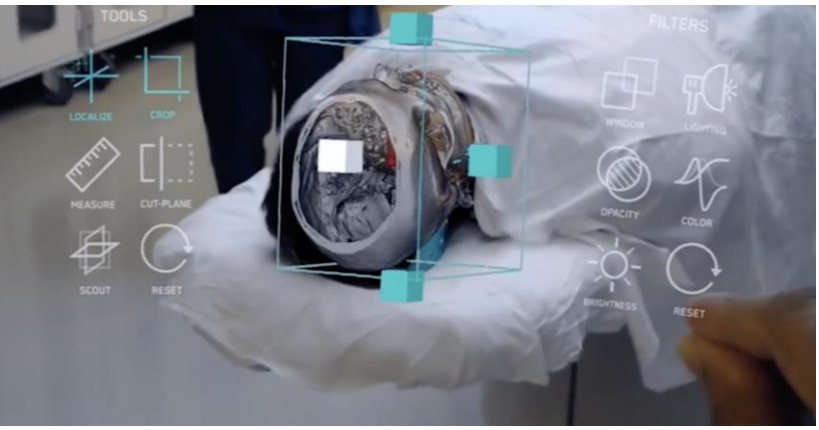
Chris Morley
Radiologist
Medivis

Increasing patient safety and improving operational precision are both top of mind for Healthcare organizations implementing Mixed Reality for Contextual Data Overlay, and Medivis's Surgical AR software on HoloLens 2 brings both of these outcomes into focus. With the ability to overlay high fidelity, 3D images of complex pathology directly onto the patient, surgeons are able to make more informed decisions before and during surgery, consequently improving accuracy; for instance, Medivis has placed catheters with millimeter accuracy in a fraction of the time. Moreover, Contextual Data Overlay has increased patient safety by reducing exposure to radiation: at least 200 operations have been performed using HoloLens 2.



USING HOLOLENS 2 FOR CONTEXTUAL DATA OVERLAY

With over two-thirds of current users estimating an ROI of 40% or higher for this Mixed Reality use case, Contextual Data Overlay is the surgical solution of the future. As Medivis Radiologist Chris Morely explains, "Holographically overlaying patient data at the point of care can reduce procedure times, complication rates, and radiation exposure." Yet, while the benefits of employing Contextual Data Overlay are tangible, almost one-third of Healthcare organizations surveyed are neither current nor prospective users of the use case; this number is particularly high among Japanese companies, who are 14% less likely to be current users than the group as a whole (24% vs. 38%, respectively). Ultimately, despite the clear advantages offered by Mixed Reality for Contextual Data Overlay, regulatory barriers may render it one of the slower technologies to be trialed and adopted.



USING HOLOLENS 2 FOR CONTEXTUAL DATA OVERLAY

Final Thoughts

As immersive technologies continue to transform reality as we know it, Mixed Reality has emerged not as a VR-light but as a business tool in its own right. With its unique ability to blend the real and the digital, Mixed Reality offers solutions that are as diverse as they are innovative, boasting use cases ranging from training healthcare workers to improving surgical precision. Ideas that felt like science fiction just a decade ago are now quite literally at our fingertips, and bold companies must think creatively about how they can use Mixed Reality to differentiate themselves in an increasingly competitive digital marketplace.

Across markets and industries, the benefits of implementing Mixed Reality technologies are vast, and three major themes emerge. First, by integrating digital elements into real spaces, Mixed Reality reduces the constraints imposed by toggling between our physical environments and our screens. Second, Mixed Reality solutions offer distinctive advantages for education--be it corporate or academic--by allowing students and trainees to develop hands-on experience performing tasks that could be detrimental or costly if executed by novices in a real-world context. Finally, Mixed Reality allows us to do something that was previously unthinkable: be two places at once. Infinitely more sophisticated than video calling, Mixed Reality technologies can transport individuals who are miles apart into the same digital space, allowing them to interact with their surroundings and with one another as if the space between them had all but vanished. Particularly in the context of a global pandemic, this ability to emulate togetherness feels indispensable.

Detailed Research Objectives & Audience Recruit

The objectives of the research included:

1. Understand the current Mixed Reality landscape including adoption, challenges, and outcomes
2. Explore current Mixed Reality projects, including how Mixed Reality is being used within key industries and customer stories
3. Quantify ROI expectations of decision-makers and demonstrate how ROI is realized through customer stories
4. Uncover the ways in which Mixed Reality may evolve in the future

To meet the screening criteria, Mixed Reality professionals needed to be:

A business decision maker or IT decision maker at their company

Employed full-time at a mid-market or enterprise-level company (500 employees or more)

Ages 25-64

Familiar with Mixed Reality

Involved in decision making for Mixed Reality technologies

Adopting or evaluating Mixed Reality technologies

Work in Manufacturing, Healthcare, or Retail industries

Of the 251 healthcare Mixed Reality professionals interviewed for the research wave in October 2020:

100 Mixed Reality Professionals were interviewed in the US

76 Mixed Reality Professionals were interviewed in Germany

75 Mixed Reality Professionals were interviewed in Japan

Note: Research was conducted during the global COVID-19 pandemic, which was at varying stages of escalation/containment

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