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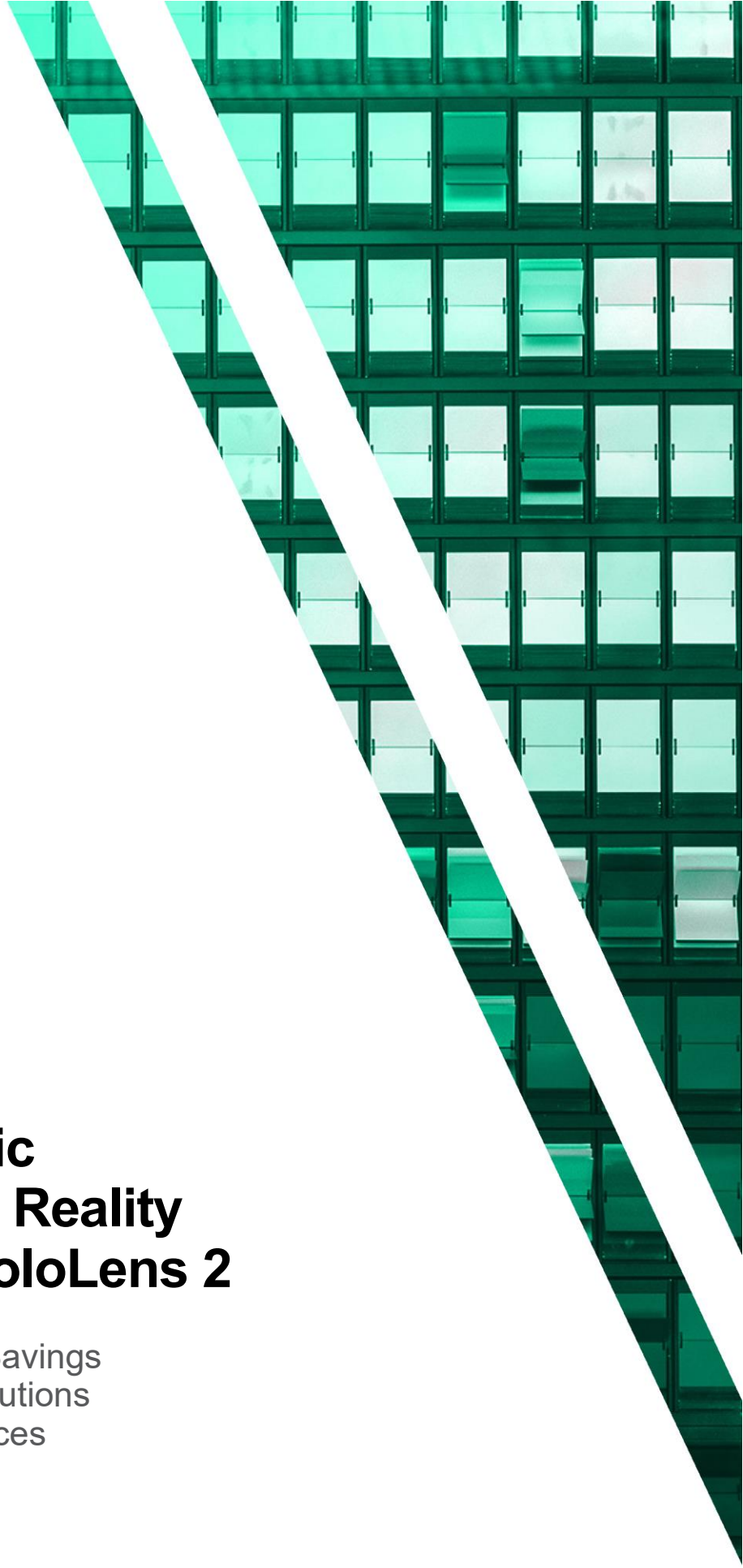

The Total Economic Impact™ Of Mixed Reality Using Microsoft HoloLens 2

Business Benefits And Cost Savings Enabled By Mixed Reality Solutions Running On HoloLens 2 Devices

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Table Of Contents

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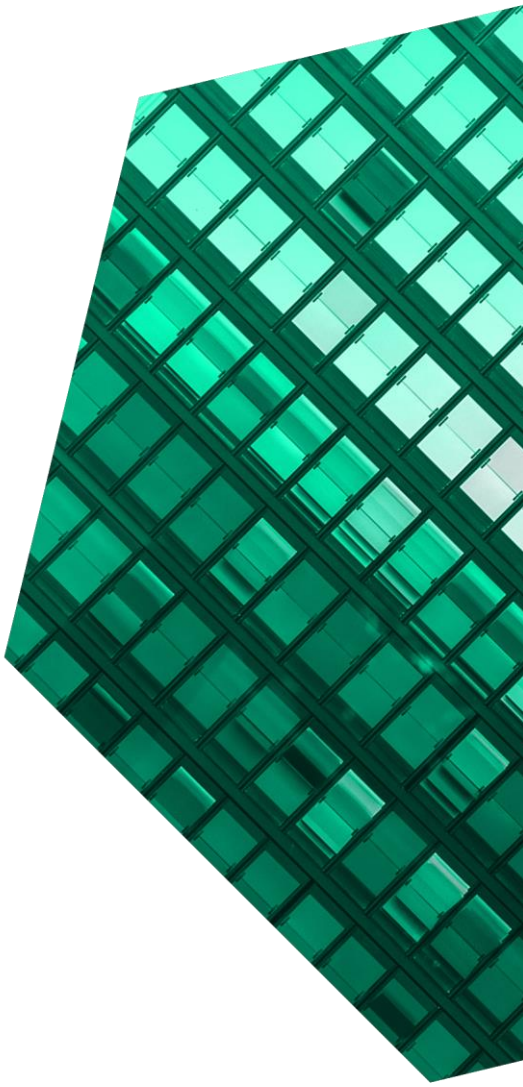


Executive Summary

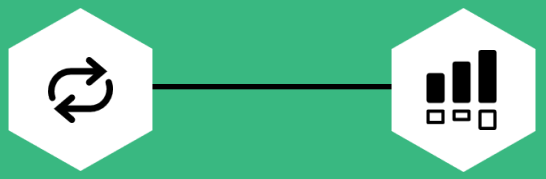
The "roaring 2020s" have propelled the world into the future of work, and organizations must innovate or be left behind. A key driver for change has emerged in the upheaval: **mixed reality,** an immersive enabling technology that overlays 3D visualizations, instructions, and simulations on real-world environments to empower workers while providing them with full movement and autonomy. Mixed reality has graduated to the here and now and is successfully delivering critical value to organizations across sectors.

Microsoft HoloLens 2 is an untethered, self-contained holographic headset that allows users to leverage enterprise-ready mixed reality (MR) applications while working "heads-up" and "hands-free." An immense breadth of MR use cases across industries and roles are possible with HoloLens 2, powered by a comprehensive ecosystem of applications and services from Microsoft and myriad third-party partners. MR on HoloLens 2 is broadly extensible; its support for custom code and cloud services has led to a growing market of customers and partners that continually expand the bounds of possibility.

Consequently, investments in HoloLens 2 are much more than a point solution or single scenario — HoloLens 2 is a general-purpose device that acts as the foundation for mixed reality innovation programs today and into the future.

Microsoft commissioned Forrester Consulting to conduct a Total Economic Impact™ study examining the potential ROI that organizations may realize by deploying mixed reality (MR) solutions using Microsoft HoloLens 2.[1] Forrester's business case analysis examines the breadth of scenarios enabled by first-party and third-party MR apps running on HoloLens 2 and highlights key insights for four industries: manufacturing; architecture, engineering, and construction (AEC); healthcare providers; and education. This study's purpose is to provide a framework for readers to evaluate the potential financial impact for their own organizations.

KEY STATISTICS



Return on investment (ROI)
177%

Net present value (NPV)
$7.6M

Data and financial analysis. Forrester interviewed 23 decision-makers from 21 organizations that are customers of Microsoft HoloLens 2 along with solution leaders from 21 MR partners to uncover key use cases and their associated benefits, costs, flexibility, and risks. Forrester aggregated customer data into a single industry-agnostic composite organization with a representative financial analysis.

Customer journey. Decision-makers invested in MR on HoloLens 2 to accomplish objectives including:

- Streamline and accelerate processes.
- Reduce errors and rework and mitigate issues.
- Ensure operational continuity.
- Protect worker health and safety.
- Better attract, hire, train, and retain employees.
- Improve bottom- and top-line business results.

KEY FINDINGS

Quantified benefits. Three-year risk-adjusted present value (PV) quantified benefits for the composite organization include:

- **Enhanced training efficiency for up to 1,000 annual trainees, saving $2.1 million in labor.** Mixed reality increased training efficiency by 60%, saving $1,440 per trainee while improving knowledge acquisition and retention.
- **Increased task efficiency for 50 field workers, saving $1.3 million in labor.** Mixed reality improved field task efficiency by 40% and reduced rework by 75%, saving $13,680 annually per field task worker.
- **Increased task efficiency for 120 onsite workers, saving $1.4 million in labor.** Mixed reality increased task efficiency by 60% and reduced rework by 50%, saving $6,540 annually per onsite task worker.
- **Improved productivity for 15 leaders, saving $428,000 in labor.** Mixed reality recaptured 30% of leaders' time for training, instruction, project coordination, planning, and customer enablement, saving $15,600 annually per leader.
- **Improved productivity and avoided travel for 15 specialized experts, saving $1.6 million in labor.** Mixed reality increased expert work efficiency by 30% and prevented 75% of major trips, saving $58,512 in annual labor costs per specialized expert.
- **Avoided travel for experts and field workers, saving $1.1 million in travel and incidentals costs.** Mixed reality reduced annual travel and incidentals costs by $31,500 for specialized experts and by $2,950 for field task workers.
- **Reduced operational costs, saving $2.9 million in excess expenses.** Mixed reality minimized consumables usage by 80% for instruction and training; materials costs by 10% for design, testing, and enablement; and PPE usage by 60% per user. MR also trimmed total business operating costs by 0.2% through better processes, quality, and maintenance.
- **Protected and grew revenue, boosting operating income by $1.1 million.** Business units leveraging mixed reality increased annual revenue by 4%.

We saw HoloLens as a game-changing technology that had an ecosystem built around it to go places. We took a leap of faith with Microsoft and very quickly confirmed it was the right decision.

— IT X-reality leader, automotive manufacturing

Qualitative benefits. HoloLens 2 also enabled the following benefits to organizations:

- Enhanced employee experience (EX).
- Better attracted, hired, and retained employees.
- Protected health and safety by minimizing exposure to work, travel, and infection dangers.
- Bolstered disaster preparedness and continuity.
- Ensured compliance with better inspections, audits, and data capture.
- Furthered sustainability goals.
- Enhanced outcomes for customers, patients, and students.

"I think Microsoft HoloLens and mixed reality are amazing. There are tons of use cases, and we're just scratching the surface at our institution and externally at companies."

Associate dean of professional and graduate programs, education

Flexibility. Customers are evaluating the potential to use mixed reality on HoloLens 2 to:

- Monetize custom mixed reality applications, scenarios, and expertise.
- Launch new customer support offerings.
- Integrate MR with Microsoft Dynamics 365 Field Service, Microsoft Mesh, or other solutions.
- Deploy MR to additional departments and roles.
- Innovate at the leading edge.
- Redesign business processes and enhance decision-making with MR data.
- Conduct mixed reality student examinations.
- Enhance clinical care.

"There is no technology on the market that can give you perspective like [mixed reality on] HoloLens can. There is nothing comparable that can give you that experience."

Corporate controls manager, construction and engineering

Costs. Three-year risk-adjusted PV quantified costs for the composite organization include:

- **HoloLens 2 device costs of $451,000** for 105 devices plus repair and device management.
- **Subscription and consumption costs of $1.2 million** for instructions, visualization, and remote collaboration capabilities.
- **Planning, implementation, and management labor costs of $2.3 million** conducted by an innovation leader, technical project managers, 3D designers, a developer, and an IT admin aided by test users and a systems integrator (SI).
- **Training costs of $304,000** for up to 1,200 mixed reality users.

Results. Forrester's risk-adjusted financial analysis for a composite organization shows a three-year ROI of 177%, an NPV of $7.6 million, and a payback period of 13 months with $11.9 million in total benefits versus $4.3 million in total costs. Mixed reality on HoloLens 2 also drove important qualitative benefits including benefits to talent recruitment, employee health and safety, business continuity, customer experience, and customer outcomes.

"We knew we were onto something when people started knocking on my door asking for HoloLens headsets."

Clinical scientist and professor, healthcare provider and education

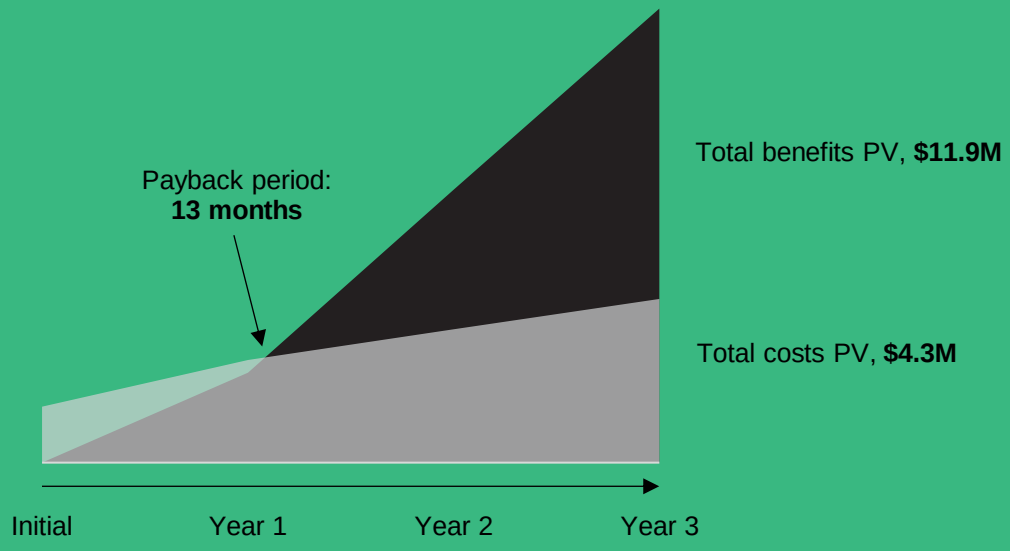
ROI
177%

BENEFITS PV
$11.9M

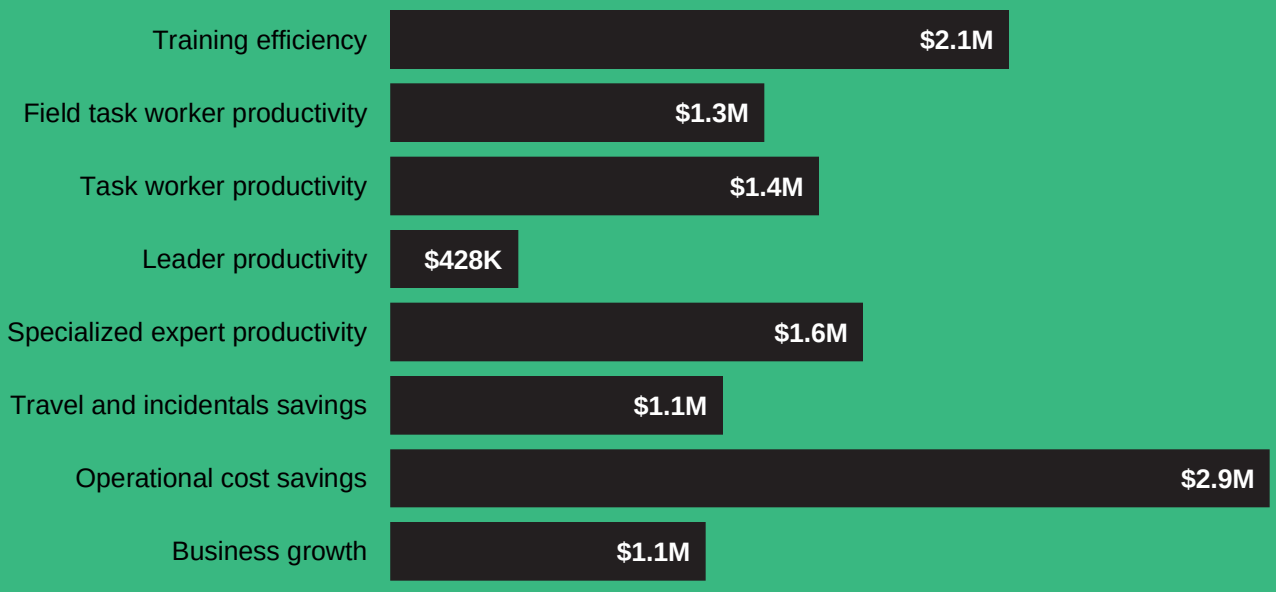
NPV
$7.6M

PAYBACK
13 months

Financial Summary



Benefits (Three-Year)



TEI FRAMEWORK AND METHODOLOGY

From the information provided in the interviews, Forrester constructed a Total Economic Impact™ framework for those organizations considering an investment in mixed reality solutions leveraging Microsoft HoloLens 2 devices and applications by Microsoft and Microsoft partners.

The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision. Forrester took a multistep approach to evaluate the impact that mixed reality solutions delivered via HoloLens 2 can have on an organization.

DUE DILIGENCE

Interviewed Microsoft stakeholders, 21 independent software vendors (ISV) and SI mixed reality partners, and Forrester analysts to gather data relative to mixed reality investments using HoloLens 2.

DECISION-MAKER INTERVIEWS

Interviewed 23 decision-makers at 21 organizations using mixed reality solutions via HoloLens 2 devices to obtain data with respect to costs, benefits, risks, and flexibility.

COMPOSITE ORGANIZATION

Designed an industry-agnostic composite organization based on characteristics of the interviewees' organizations.

FINANCIAL MODEL FRAMEWORK

Constructed a financial model representative of the interviews using the TEI methodology and risk-adjusted the financial model based on issues and concerns of the decision-makers.

CASE STUDY

Employed four fundamental elements of TEI in modeling the investment impact: benefits, costs, flexibility, and risks. Given the increasing sophistication of ROI analyses related to IT investments, Forrester's TEI methodology provides a complete picture of the total economic impact of purchase decisions. Please see Appendix A for additional information on the TEI methodology.

The Microsoft HoloLens 2 Customer Journey

Drivers leading to the mixed reality investment

STUDY OBJECTIVES AND METHODOLOGY

Data collection. Forrester conducted customer interviews with 23 decision-makers from 21 organizations that have deployed a range of mixed reality applications via Microsoft HoloLens 2 devices:

- Off-the-shelf applications from Microsoft including **Dynamics 365 Remote Assist and Guides.**
- Off-the-shelf applications offered by **partner independent software vendors (ISVs).**
- Custom-built or heavily customized applications built by **partner systems integrators (SIs).**
- **Custom-built applications** by internal teams.

Interviewed customer decision-makers represent a diverse array of roles, industries, and regions. Customer organizations generated at least $500 million in annual revenue, with most interviewed organizations generating $5 billion to $40 billion annually. Mixed reality deployments ranged from five to 400 Microsoft HoloLens 1 and 2 devices and had been leveraged by 10 to 3,000 users at the time of interviews. Organizations employed mixed reality for a vast breadth of use cases today and are planning for significant expansion. Learn more about Forrester's customer interviews in Appendix B.

Forrester also conducted partner interviews with solution leaders from 13 ISVs and eight SIs that offer mixed reality solutions for HoloLens, plus Microsoft stakeholders representing HoloLens 2, Azure, and Dynamics 365. Forrester enhanced and validated the findings and analysis using more than 50 Forrester research reports, Forrester analyst expertise, third-party research, and public market data.

Modeling mixed reality's impact. Forrester used this data to quantify the financial impact for organizations deploying mixed reality applications on Microsoft HoloLens 2 devices. The core analysis is an aggregate view that applies across industries, with unique findings and variation illustrated as they apply specifically to the following four industries:

- Manufacturers across subsectors.
- Architecture, engineering, and construction (AEC) firms.
- Healthcare providers.
- Education providers.

Data Demographics

Data collected:
• Interviews with 23 decision-makers from 21 organizations using Microsoft HoloLens 2
• Interviews with 13 leaders from mixed reality ISVs and eight leaders from mixed reality SIs
• Forrester and third-party research
• Public market data

Primary industries:
• Manufacturing
• AEC
• Healthcare
• Education

Organization sizes:
Enterprises with between $500 million and $100 billion in annual revenue

Regions:
Organizations based in North America, Europe, and Asia with global operations

Mixed reality deployment size:
Deployments ranged from five to 400 Microsoft HoloLens 1 and 2 devices with between 10 and 3,000 mixed reality users

MARKET OVERVIEW

The “roaring 2020s” have started with a force: a global COVID-19 pandemic that is propelling organizations into the future of work. Like its namesake decade from the 20th century, the 2020s will be full of challenges. Systemic risk now leaves every organization globally exposed, and all must react today. But this time, many of the forces that determine who will win or lose are already visible — and just got fast-tracked.[2]

During this time, organizations that already deployed extended reality (XR) solutions such as mixed reality have found themselves ahead. Their leading-edge investments are bearing fruit such as protecting business continuity, health and safety; improving customer experience (CX) and employee experience (EX); and enhancing their ability to attract, hire, and retain employees.

Meanwhile, savvy leaders at other organizations across industries have noticed. Realizing that XR is a crucial part of the arsenal to survive and thrive, numerous decision-makers have now turned to XR technologies such as mixed reality out of necessity. Even for pandemic-inspired entrants, these new changes appear unlikely to reverse course.[3] Mixed reality has proven its potential, and decision-makers are now actively exploring and developing the next stages in this technology’s future.

Mixed reality definition. Mixed reality (MR) is the virtual overlay of contextual digital information into the real world using 3D holographic objects, anchoring points, and heads-up, hands-free movement. Mixed reality is an immersive enabling technology within the XR spectrum that unifies and expands augmented reality’s (AR) overlays and communication with virtual reality’s (VR) 3D simulations. Mixed reality allows the interaction of real-world environments with three-dimensional digital objects, instructions, data, and virtual collaborators.[4]

Using Microsoft’s HoloLens 2, users put on a head-mounted wearable computer with see-through display that constructs expansive visual, digital environments including 3D, motion-capable holograms that augment real-world objects and spaces. Users such as frontline workers can follow holographic instructions and plans while also “marking up” reality with reference and collaboration information. While wearing HoloLens 2, users experience audio and visuals, can manipulate the device with voice and gestures, and can participate in real-time communication. These features enable benefits such as efficiency, accuracy, and innovation. Microsoft apps such as Remote Assist and Guides, partner apps, and Microsoft Azure services such as Spatial Anchors allow further sophisticated capabilities for myriad use cases.

“If you don't invest in [mixed reality] innovation today … you would be far behind. You’d need to start from the beginning, while others can easily adapt with the knowledge they’d already learned. This is crucial, because we never know when there might be a point of change like touchscreens. At first, no one could use them and didn’t want them. But suddenly, everyone switched and companies that didn’t invest got left behind.”

X-reality innovation leader, robotics manufacturing

Top use cases for mixed reality. Mixed reality can apply to virtually any industry such as: manufacturing, architecture, engineering, construction, healthcare, education, telecommunications, energy, utilities, defense, IT services and support, consulting, retail, and transportation. Certain general use cases such as training, auditing, collaboration, IT support, facilities, and inventory can also apply to almost all industries. MR use cases and value recognition therefore vary considerably for every organization. Forrester has identified the following common value-producing scenarios that apply across industries:

- **Training.** MR enables self-guided user training that leverages detailed visual models and instructions and the ability for users to repeatedly try tasks for themselves — or to use it in real time on the job. Training is aided through real-time remote demonstrations of experts and, conversely, observation and evaluation of the trainee by instructors. MR training can overlay simulations on physical spaces or items such as machines, lab materials, or mannequins.
- **Task instructions and visualization.** MR enables users to view task instructions, essential data, and model visualizations while working heads-up and hands-free. Users can complete tasks independently to do work faster with fewer errors and less support.
- **Remote collaboration.** MR enables users to collaborate, get advice, or view demonstrations worldwide using heads-up, hands-free real-time video calls enhanced with holographic markup. From learning to innovation and from inspections to repairs, remote collaboration enables many scenarios with minimal deployment effort.
- **Design and decision-making.** MR enables leaders, stakeholders, and workers to evaluate designs and plans in the real world to ideate solutions, test for issues, gain buy-in, co-create with customers, and shorten timelines without expensive and time-consuming physical models.
- **Sales and customer enablement.** MR can demonstrate plans visually and in the real world, helping gain buy-in and close deals.

Voice Of The Customer

"Mixed reality is the middle ground between virtual reality and augmented reality. You are sufficiently immersed to clearly see and interact with digital models and data but not so immersed that you cannot do your work in the field. The transparent nature of the device allows you to continue doing your work while also having a relatively realistic experience of the data, information, or models."
— Product line general manager, industrial manufacturing

"There's not another way to do this without tech like mixed reality because you need to consider the accurate picture of the world around you."
— Corporate controls manager, construction and engineering

"[Mixed reality] is the future of learning technology. I just can't imagine a university campus that will not have XR technologies in the future. This is coming, this is effective, and this is going to be the way we do work. The future of work needs to be part of the future of education. It's transformative."
— Executive director of innovation, education

"HoloLens helps us walk a site safely to identify and track complex connections and parts through a congested environment. It lets us stay safe while working much more quickly and effectively with visualization-aided context."
— VP of design and engineering, construction and engineering

The evolution of mixed reality deployments. The barriers to entry for investing in MR have drastically declined in the past several years. Applications from Microsoft and partners have developed considerably in their breadth and stability of capabilities. Many more use cases continue to be standardized and tested both by these application vendors and by other customers themselves.

The COVID-19 pandemic has been a major forcing mechanism for business change, driving an uptick in MR adoption. It has accelerated organizations that were considering, exploring, or testing mixed reality to fully deploy solutions to end users. It has also led to significant innovation for new use cases and industries; for example, MR had already achieved notable adoption in manufacturing sectors but is now also being widely tested and deployed in healthcare and education. Regardless of how the pandemic continues to evolve, barriers have already been surmounted: MR's growth seems likely to hold strong and continue its growth trajectory.

Mixed reality's continued growth is great news for readers. As the path becomes increasingly traversed with ever better prebuilt offerings, new organizations can progressively adopt mixed reality at lower cost, labor, and risk and generate business value faster. And as common use cases and their business impact become increasingly stable and accepted, organizations can increasingly expand the realm of possibility for use cases across industries.

How to evaluate mixed reality opportunities. Readers must first evaluate current challenges and opportunities to determine which use cases offer the greatest potential value with the lowest-possible barriers. Most organizations today will be best suited to start with prebuilt apps, which enable faster deployment with lower costs and risks to quickly deliver value and prove the concept. Early business value justification drives adoption as well as growing expertise and understanding of MR for technical teams, end users, and leaders.

Voice Of The Customer

"We are pretty convinced that the HoloLens and mixed reality is going to be a major, major field in the future of healthcare not just in image guidance but in the overall integration of data and how we actually perceive data within the hospital."
— Surgeon and medical education director, healthcare provider and education

"HoloLens really flourishes when you have existing facilities or structures that you are adding to or modifying in some way."
— Corporate controls manager, construction and engineering

"People work with two hands; they don't work with one. Taking the time to set down and pick up instructions isn't adequate. To help, people need to see what you're doing, and that only works if it's from a device on your eyes. Setting down a phone with video isn't enough to see what you're seeing, and your hand or angles can block the view."
— Training and technical services director, life sciences manufacturing

Organizations can then begin adding more use cases and increasing scale. They may add additional apps or functionality, and when gaps are identified in the available solutions, they may also pursue customization and custom development. Given the higher cost, time, and labor requirements of custom development, it is typically best reserved for high-value internal opportunities or those that could be monetized in the long term through packaged offerings or IP licensing. Custom development efforts are more likely to succeed after first surmounting simpler mixed reality opportunities and gaining internal expertise and leadership support.

INVESTMENT DRIVERS

There are many journeys that customers undertake as they investigate and invest in mixed reality solutions. Understanding the drivers and objectives for these investments is crucial in evaluating their financial and qualitative impact on a business.

Challenges. Decision-makers investigated how mixed reality could solve key challenges, including:

- **Excess rework and downtime.** Slow response speed, lack of knowledge, and human errors led to wasted costs and labor, project delays, and failed to address issues quickly — hurting CX, operating margins, and even revenue generation.
- **Inefficient training, instruction, and work processes.** Organizations could not meet current demands for speed, capacity, or quality with their current workforces and processes.
- **Staffing shortages and turnover.** All industries struggled to attract, hire, train, and retain skilled employees to ensure continuity and keep up with demand — especially niche or aging experts.
- **The COVID-19 pandemic.** The pandemic forced organizations to find ways to operate with little-to-no travel and physical interaction, disrupting everything from repairs and inspections to hospital ward rounds and classroom lab work. Mixed reality solved situations where video conferencing and written instruction fell short.

"We would not be able to offer the help to [remote sites] that we are offering with the HoloLens without it. It would not be replicable."

Global health program manager, healthcare provider

Challenges Leading To Mixed Reality Investments By Industry

Manufacturing	AEC	Healthcare providers	Education
• Firms struggled with some inconsistent or poor service quality, hindering customer experience (CX). • Travel restrictions due to the pandemic prevented or increased risks of travel for crucial deployments, inspections, and repairs. • Field workers had limited knowledge which caused excess repeat trips, the need to send multiple technicians, and occasionally the need to send high-cost experts. • Avoidable errors caused expensive rework and delays. • Training field employees was cost prohibitive due to travel costs and time. • High staffing turnover and shortages hindered the ability, speed, and cost of hiring and training of enough workers to meet demand. • Firms struggled with expensive fabrication and transportation of models for sales and design phases.	• Firms struggled with some inconsistent or poor service quality, hindering customer experience (CX). • Firms failed to catch some clashes, hazards, and other issues — causing rework costs, delays, and poor CX. • Sales, planning, and design processes took too long. • Designers, engineers, site workers, and customers failed to align on plans, causing dissatisfaction and delays. • Training field employees was cost prohibitive due to travel costs and time. • High staffing turnover and shortages hindered the ability, speed, and cost of hiring and training of enough workers to meet demand. • Firms struggled with expensive fabrication and transportation of models (such as architectural maquettes) for sales and design phases.	• Providers needed to minimize viral exposure and work with extremely limited personal protective equipment (PPE). • Providers needed to learn new skills and new equipment due to the pandemic but travel restrictions, overwhelmed staff, and quickly evolving data from the novel virus created a training and support gap. • Medical device and product manufacturers could not provide adequate education, installation, and support due to pandemic travel restrictions. • The pandemic limited field providers' ability to care for patients, especially for home visits and assisted living. • Staff training and continuing education faced the same limits described for education providers.	• The pandemic forced classes to operate remotely, but virtual classroom and collaboration technology could not replicate lab work and observation. • Scarce, expensive, and expendable lab materials limited students' ability to try and practice tasks (especially in medical education). • Live observation had limited capacity and was limited to on-site expertise and students. • Video streaming and recordings had limited educational value. • Travel expense and time limited research collaboration between sites and universities, conference participation, and other opportunities. • Competition pushed schools to teach technology skills and demonstrate innovation.

Opportunities. Decision-makers also investigated mixed reality to seize new opportunities, including:

- **Offer new training experiences to boost knowledge transfer and retention and improve outcomes.** Decision-makers sought to create training programs that could be self-paced with reduced instructor time; reach more trainees or students; and provide better visualization, understanding, hands-on experience, and repeatability to boost knowledge acquisition and retention, and therefore, improve outcomes. These opportunities were particularly critical given the retirement crisis in manufacturing and AEC and staff shortages across sectors.
- **Enable salespeople, customers, designers, engineers, managers, and task workers to collaborate.** Interviewees sought tools to help all key stakeholders better share, visualize, and review plans to boost sales, align teams faster, improve EX, reduce rework, and prevent delays.
- **Revamp processes to reduce the number of workers needed onsite.** Interviewees wanted to empower frontline workers and decrease the number of people traveling and participating in person, both by creating more effective instructions and enabling remote collaboration.
- **Facilitate effective remote innovation and collaboration.** Decision-makers sought to boost collaboration between teams in different locations and at other organizations, helping everyone to increase knowledge and drive innovation.
- **Build resellable mixed reality experiences.** Interviewees built or customized applications to accomplish new use cases not yet addressed by mixed reality; these solutions could be packaged and resold to customers (such as for support) or licensed to other companies similar to an ISV (such as a widely applicable training program), driving new revenue streams.

"We were building a new healthcare education campus and wanted to make sure we integrated future-focused technology."

Executive director of innovation, education

Opportunities Identified For Mixed Reality Investments By Industry

Manufacturing	AEC	Healthcare providers	Education
• Reduce the number of people needing to travel • Enable remote inspections • Enable remote servicing • Provide heads-up, hands-free instructions to improve worker speed, quality, and safety • Empower workers with self-guided learning • Minimize back-and-forth in sites like clean rooms or on ladders • Build and sell support models including custom mixed reality apps and HoloLens 2 devices • Demonstrate offerings in 3D to customers to enable sales	• Provide heads-up, hands-free instructions to improve worker speed, quality, and safety • Empower workers with self-guided learning • Demonstrate plans and models in 3D to customers to enable sales and improve service • Overlay designs on physical locations to identify issues and gain buy-in of onsite workers and key stakeholders	• Enable and enhance training with experts around the world • Collaborate with remote experts for diagnoses • Install and support equipment faster and at lower cost • Boost efficiency of care, such as with ward rounds • Provide better remote care, such as specialists supporting a general practitioner at a nursing home • Investigate long-term innovation in healthcare, such as visualization	• Grow research collaboration with other sites and institutions • Teach new skills not possible with current educators, labs, and resources • Enhance Q&A and feedback during demonstrations • Enable mixed reality skill assessments

Objectives. Decision-makers hoped to achieve the following goals with mixed reality, including:

- Improve EX, collaboration, and upskill teams.
- Empower workers and enhance outcomes with self-guided, portable training.
- Better attract, hire, and retain employees.
- Streamline and accelerate processes.
- Prevent errors and rework.
- Fix issues and complete deployments faster and more efficiently.
- Increase capacity and throughput.
- Reduce expected and excess operational costs.
- Improve outcomes for customers and users.
- Enhance CX.
- Boost sales and revenue.
- Ensure business continuity.
- Protect worker and customer health and safety.
- Reduce environmental impact.
- Improve brand image.

"Any technology that can improve the installation of the work to improve efficiency or quality has a direct impact to our bottom line as an organization. We do anything and everything we can to make our projects and our work more efficient and more streamlined."

Corporate controls manager, construction and engineering

Objectives For Mixed Reality Investments By Industry

Manufacturing	AEC	Healthcare providers	Education
• Ensure continuity, especially during the pandemic • Protect health and safety • Accelerate training and reduce training costs • Improve learning and knowledge retention • Accelerate task completion • Improve quality of work • Improve first-time fix rates • Reduce errors and rework • Minimize downtime • Accelerate production, deployments, and service • Increase capacity • Reduce demand and stress on leaders and experts • Avoid travel costs • Improve CX • Increase sales • Reduce operating costs and improve profit margins • Improve EX • Enable innovation • Strengthen brand image	• Accelerate training and reduce training costs • Protect health and safety • Accelerate design and planning phases • Improve learning and knowledge retention • Improve alignment and buy-in for office teams, site workers, and customers • Accelerate task completion • Improve quality of work • Reduce errors and rework • Reduce demand and stress on leaders and experts • Reduce pass-along costs for customers of delays and rework • Improve CX • Strengthen brand image • Increase customer retention, enrichment, and advocacy • Increase contracting win rates	• Ensure continuity, especially during the pandemic • Protect health and safety • Minimize exposure risk to diseases, including COVID-19 • Train staff more quickly • Improve knowledge retention for training • Improve patient outcomes • Reduce costs for training consumables and PPE • Increase staff efficiency and capacity • Support more locations • Boost community impact • Grow revenue • Strengthen provider prestige and competitiveness	• Ensure continuity, especially during the pandemic • Enable remote learning • Increase knowledge retention • Improve student experience • Enhance student outcomes in the workplace • Increase professor capacity for students and research • Reduce operating costs for consumables and lab space • Increase research quality • Strengthen university prestige and competitiveness

Solution criteria. Investing in mixed reality is more than a vendor selection — it is a net-new category of technologies to explore. After identifying challenges and opportunities, decision-makers evaluated many different technology categories to determine which ones could help meet their objectives. They identified the potential of extended reality and then determined that mixed reality would be an appropriate choice. Decision-makers then evaluated applications, devices, and partners for deployment and management in tandem, selecting a comprehensive solution rather than individual parts.

Interviewees for this study ultimately selected Microsoft HoloLens 2 devices with a range of applications such as Microsoft Dynamics 365 Remote Assist and Guides, ISV partner applications, and custom-built solutions based on the following criteria:

- **Heads-up, hands-free work and collaboration with robust capabilities and dependability.** Mixed reality enabled use cases typically possible with AR and VR while providing significant additional value at their intersection. HoloLens 2 enabled accurate real-world overlay of 3D assets, instructions, and collaborative markup while leaving workers free to see their surroundings and use both hands — providing a vast array of use cases with the trustworthiness, safety, and efficiency workers needed.
- **Availability of specialized devices such as HoloLens 2 Industrial Edition and hard-hat integration options.** Decision-makers enabled more valuable scenarios by using mixed reality in clean rooms or at hazardous sites while meeting necessary safety and emissions requirements.
- **Market recognition and growth of HoloLens 2.** Decision-makers derisked their extended reality investments by basing their efforts on HoloLens 2 given its significant market adoption and growth.
- **Simplicity to embed within Microsoft's ecosystem including Azure, Intune, Active Directory, Dynamics 365, Office, and Teams.** Decision-makers selected HoloLens 2 to accelerate time-to-value and reduce operational overhead with established ecosystems of Microsoft services, avoiding major customization, coding, or investment in other new tools.
- **Breadth and growth of mixed reality platform capabilities.** The availability and continuing advancement of application and Microsoft Azure capabilities for mixed reality allowed decision-makers to accomplish today's use cases while providing flexibility for future ones using the same underlying technology.
- **Robust partner ecosystem of ISVs and SIs, many with highly specialized industry expertise and offerings.** The large and growing selection of ISV applications and SI expertise for mixed reality on HoloLens 2 enabled customers to accomplish a vast array of industry-specific use cases while lowering risk, accelerating deployment, and reducing costs.
- **Successful proofs of concept (POCs).** Decision-makers ran small POCs for mixed reality applications and HoloLens 2 to test the concept and gain buy-in from key stakeholders with fast results.

"We found HoloLens to be a great tool initially to go into the field, pull up a specific area and model, and determine clash detection. Then we used it to get buy-in from the field and make modeling more efficient with higher quality. This mitigated risk as we continued through the construction process."

VP of design and engineering, construction and engineering

COMPOSITE ORGANIZATION

Forrester aggregated findings from 21 customer organizations with research data and industry metrics to design a composite organization and an associated ROI analysis that is representative of interviewees' experiences.

Forrester's TEI model for mixed reality on Microsoft HoloLens 2 is industry-agnostic. Forrester blended assumptions, costs, benefits, and risks from across the sectors covered in this research to form a representative baseline analysis. Because industries may realize financial results differently, Forrester has also provided industry-specific insights and metrics throughout this study to guide readers.

Composite description. The composite organization is a global for-profit business based in North America that sells complex services and supports customers globally. It earns at least $1 billion in total revenue per year and employs over 5,000 FTEs globally.

Deployment characteristics. Forrester's mixed reality TEI analysis for the composite organization is based on the following representative assumptions:

- A team of nine technologists deploy and manage mixed reality via HoloLens 2.
- The composite purchases 100 HoloLens 2 devices for end users and five HoloLens 2 devices for development and testing.
- The composite deploys prebuilt applications that are representative of those offered by Microsoft and ISV partners for remote collaboration, instruction, and visualization.
- Two hundred end users leverage mixed reality regularly throughout the year.
- Up to 1,000 general business users receive training via mixed reality each year.

Mixed Reality Users And Technologists At The Composite Organization

User Role	Employee Location	Number Of Users	Fully Burdened Salary*
The following end users leverage mixed reality on HoloLens 2 to streamline and enhance their work:			
Field task workers	Dispersed globally with regional coverage of company and customer sites	50	$45 per hour
Onsite task workers	Major company sites	120	$30 per hour
Project and site leaders	Major company sites	15	$50 per hour
Specialized experts	Any location; support critical needs at all global company and customer sites	15	$92 per hour
General business users	Any location	500 to 1,000 per year	$30 per hour
The following technologists implement and manage the mixed reality deployment for the composite organization:			
Extended reality leader	Any location, supports global deployment	1 (partially dedicated)	$120 per hour
Technical project managers	Any location, supports global deployment	3 (partially dedicated)	$50 per hour
Developers	Any location, supports global deployment	1 (partially dedicated)	$63 per hour
3D designers	Any location, supports global deployment	3 (partially dedicated)	$40 per hour
IT administrators	Any location, supports global deployment	1 (partially dedicated)	$58 per hour

*Fully burdened salaries are modeled using Payscale.com data for typical roles across the four primary industries and are burdened with an average of 35% in additional employment costs beyond salary.

Analysis Of Benefits

Quantified benefit data as applied to the composite

Total Benefits

Ref.	Benefit	Year 1	Year 2	Year 3	Total	Present Value
Atr	Training efficiency	$324,000	$972,000	$1,296,000	$2,592,000	$2,071,555
Btr	Field task worker productivity	$309,825	$615,600	$615,600	$1,541,025	$1,252,929
Ctr	Task worker productivity	$353,160	$706,320	$706,320	$1,765,800	$1,435,459
Dtr	Leader productivity	$105,300	$210,600	$210,600	$526,500	$428,004
Etr	Specialized expert productivity	$371,358	$789,912	$789,912	$1,951,182	$1,583,891
Ftr	Travel and incidentals savings	$256,500	$558,000	$558,000	$1,372,500	$1,113,573
Gtr	Operational cost savings	$607,776	$1,419,721	$1,623,891	$3,651,388	$2,945,900
Htr	Business growth	$260,000	$520,000	$520,000	$1,300,000	$1,056,799
	Total benefits (risk-adjusted)	$2,587,919	$5,792,153	$6,320,323	$14,700,395	$11,888,110

Benefits (Three-Year)

Benefits overview. Forrester's model for the composite organization is a conservative representation of the total benefits achieved by interviewees' organizations, adjusted relative to organization size, industry, and use cases. Learn more about the composite organization and Forrester's methodology for this study.

"When you get someone to put on a HoloLens, all you have to do is watch their expression. You'll know if they understood it. Ninety-nine times out of a 100, you see the instant smile come across their face and the instant enthusiasm. Now they understand, and their brain starts thinking about all the cool things they can do for the business."

Innovation product director, power manufacturing

TRAINING EFFICIENCY

Self-guided mixed reality instructions leverage 3D models, simulations, and real-world overlays to enable employees or students to learn more quickly, better understand content, and practice skills. Learners can also observe and participate in remote demonstrations or be evaluated by viewers as they test their new skills. Mixed reality not only accelerates training to allow labor recapture but also improves knowledge acquisition and retention to improve outcomes and reduce future training needs. Fast and effective training continues to gain importance as organizations across industries struggle to attract, hire, and retain crucial talent.

Mixed reality increased training efficiency by **60%**, saving **$1,440** per trainee while improving knowledge acquisition and retention.

Industry impact. Training benefits are expressed uniquely by sector, including:

- **Manufacturers reduced training time by 75%, at an average savings of $30 per labor hour.** Manufacturing firms must offer expansive training programs to teach skills and processes specific to their offerings. These tasks are highly standardized processes with preexisting 2D instructions and models, enabling faster deployment of mixed reality training across a broader slate of tasks than for most industries.
- **AEC firms reduced training time by 50%, at an average savings of $22 per labor hour.** AEC firms must teach company-specific skills and processes that are ripe for MR, though more skills are applicable across firms. Most firms have standard processes and preexisting 2D models and instructions to fast-track training creation.
- **Healthcare providers reduced training time by 30%, at an average savings of $63 per labor hour.** Building self-guided MR training for healthcare was particularly challenging due to high complexity, nuance, variation, and need for professional judgment. However, MR significantly improved visualization and enabled users to practice skills — significantly enhancing knowledge acquisition and retention. Most of today's mixed reality healthcare trainings are primarily focused on observation rather than self-guided trainings, which provided less trainee efficiency but significant learning value.
- **Educators reduced training time by 30%, driving qualitative benefits for students.** Educators primarily used MR training for healthcare instruction, with the same benefits and trends as for providers. However, time saved cannot be monetized, as students are not paid — rather, time saved instead boosted student engagement, performance, and placement, as well as enabled more learning opportunities.

Evidence and data. Interviewees shared many examples of mixed reality training benefits, including:

- **A life sciences manufacturer slashed one-on-one training costs while improving learning.** The training and technical services director shared, "A major part of how we end up paying for mixed reality technology is by stopping the high-cost, high-expense training and replacing it with more effective, immersive technology."
- **An education organization found that medical students learned twice as fast with mixed reality compared to traditional methods and enhanced long-term knowledge retention.** The executive director of innovation said: "The visual quality of mixed reality makes it easier to discern anatomical structures, see where they're located, and understand how they relate to each other within the human body. It's so much easier to visualize and comprehend in this 3D, digital way."

- **A healthcare and education organization used HoloLens 2 to enable live observations.** The surgeon and medical education director shared: "We are streaming tutorials live with the HoloLens via Remote Assist to users watching on Teams, which allows students and practitioners who are not physically present to dial in and interact with tutors and patients as they learn."

Modeling and assumptions. Forrester modeled the impact for the composite organization assuming:

- General business workers from across the organization take part in training curricula that require an average of 80 labor hours without MR.
- The composite trains 500 workers with HoloLens 2 in Year 1, increasing to 1,000 workers per year by Year 3 as the organization builds out further materials and gains organizational support.
- Mixed reality reduces training time by up to 60%, with all time savings recaptured for added value as trainees can get to work sooner.

Risks. The expected financial impact is subject to risks and variation based on several factors:

- Mixed reality's ability to supplement or replace training and its associated benefit will depend on the specific users, tasks, and functions.
- Training savings hinge on the upfront investment of building relevant and high-quality MR curricula.
- Savings recaptured will depend upon the number of users reached and their average labor cost.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV (present value discounted at 10%) of $2.1 million.

"HoloLens has significant advantages for technical skill acquisition over simple video, two-dimensional digital technologies, or standard adaptive learning."

Clinical scientist and professor, healthcare provider and education

Training Efficiency

Ref.	Metric	Source	Year 1	Year 2	Year 3
A1	Typical training hours per trainee	Composite	80	80	80
A2	Reduction in training time with MR	Interview data	30%	60%	60%
A3	Hours recaptured per trainee with MR	A1*A2	24	48	48
A4	Fully burdened hourly compensation for general workers	Payscale.com, multi-industry average	$30	$30	$30
A5	Training labor cost saved per trainee	A3*A4	$720	$1,440	$1,440
A6	Number of annual trainees	Composite	500	750	1,000
At	Training efficiency	A5*A6	$360,000	$1,080,000	$1,440,000
	Risk adjustment	↓10%			
Atr	Training efficiency (risk-adjusted)		$324,000	$972,000	$1,296,000
	Three-year total: $2,592,000			**Three-year present value: $2,071,555**	

FIELD TASK WORKER PRODUCTIVITY

Field workers more quickly and effectively completed tasks by using heads-up, hands-free instructions enhanced by detailed visualizations overlaid on the real world. Real-time remote collaboration enabled "see what I see" assistance to complete work or resolve issues beyond the workers' expertise without requiring extra trips. Field workers consequently saved time, prevented errors and rework, avoided excess trips, and increased their capacity.

Mixed reality improved field task efficiency by **40%** and reduced rework by **75%,** saving **$13,680** annually per field task worker.

Industry impact. Field task worker benefits are expressed uniquely by sector, including:

- **Manufacturers improved efficiency by 60% for half of fieldwork tasks and reduced rework by 75%, saving $49 per hour.** Site visits, product deployments, inspections, maintenance, and repairs can all be assisted by instructions, visualization, and remote collaboration. Field technicians, engineers, or support staff typically support customer- or company-owned sites within a particular region. Boosting efficiency and quality of work increases their capacity for work and improves customer outcomes. ROI was particularly high for complex, expensive products.
- **AEC firms improved efficiency by 20% for 30% of fieldwork tasks and reduced rework by 75%, saving $44 per hour.** AEC field workers conducted design evaluations, installations, and inspections aided by design visualization and remote collaboration to drive project speed, cost savings, quality of work, and CX. More complex projects yielded higher ROI opportunity.
- **Healthcare providers were investigating field work opportunities.** Leaders are evaluating the potential to provide or enhance care for field sites (primarily with specialists) like assisted living, general practitioner offices, and rural practices.
- **Education providers were investigating fieldwork opportunities.** Prospective uses could include field researchers aided by visualizations or collaboration apps or traveling educators teaching advanced concepts with mixed reality.

Evidence and data. Interviewees shared many examples of mixed reality field benefits, including:

- **A life sciences manufacturer slashed support costs by 30%, doubled customer response speed, and improved mean time to repair (MTTR) by 20% for field service calls.** Remote support and MR instructions dubbed "electronic mentors" improve quality of work, expedite first-contact resolution, and significantly reduce cost and demand for experts. The organization used Microsoft Dynamics 365 Remote Assist and Guides to support the effort and is in the process of scaling up mixed reality support, aiming to cover all of its 20,000 annual service calls.
- **An AEC firm streamlined fieldwork using task lists, recording capabilities, and remote collaboration.** The company has reduced the number of employees needing to travel onsite without negative repercussions, saving costs and protecting worker health and safety.
- **An IT services company improved first-time fix, boosting capacity to support customers.** The product manager shared: "One-third of field tech visits require a return visit. With Remote Assist, they can achieve first-time fix, which reduces ticket volume. Technicians work on three tickets per day, and instead of returning to a site from the previous day, they can work three new tickets the next day."

- **A healthcare provider piloted collaboration between a general practitioner in the field and specialists from a hospital.** Together, they provided visualization-aided consultation and collaborated on decisions. The pilot was well received, with the doctor and chief clinical information officer sharing, "Citizens, relatives, nursing home staff, hospital staff, and the general practitioner all really liked our field tests."

Modeling and assumptions. Forrester modeled the impact for the composite organization assuming:

- The composite deploys HoloLens 2 devices to 50 field task workers who spend 75% of their time in the field (1,560 hours per year).
- Up to 30% of field tasks are supported by mixed reality, which achieve a 40% efficiency increase.
- Ten percent of fieldwork is rework and follow-ups, up to 75% of which are prevented using MR.

Risks. The expected financial impact is subject to risks and variation based on several factors:

- MR's ability to aid task work will vary by specific supported tasks and depend on the availability of remote experts and site conditions such as heat, sunlight, safety risks, and network connectivity.
- Achieving savings relies on building relevant and high-quality MR guides and/or models, for which the availability and cost of getting the right data to feed 3D models can be a significant inhibitor.
- Recaptured savings will depend upon the number of users reached and their average labor cost.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV of $1.3 million.

Field Task Worker Productivity

Ref.	Metric	Source	Year 1	Year 2	Year 3
B1	Typical field working hours per year	Composite	1,560	1,560	1,560
B2	Percentage of tasks supported by MR	Interview data	15%	30%	30%
B3	Increase in task efficiency with MR	Interview data	40%	40%	40%
B4	Hours saved through MR efficiency (rounded)	B1*B2*B3	94	187	187
B5	Percentage of task time used for rework or follow-up visits	Interview data	10%	10%	10%
B6	Reduction in rework and follow-up trips with MR	Interview data	38%	75%	75%
B7	Hours saved through MR quality (rounded)	B1*B5*B6	59	117	117
B8	Hours saved per field worker	B4+B7	153	304	304
B9	Fully burdened hourly compensation for field task workers	Payscale.com, multi-industry average	$45	$45	$45
B10	Labor cost saved per worker	B8*B9	$6,885	$13,680	$13,680
B11	Number of field task workers	Composite	50	50	50
Bt	Field task worker productivity	B10*B11	$344,250	$684,000	$684,000
	Risk adjustment	↓10%			
Btr	Field task worker productivity (risk-adjusted)		$309,825	$615,600	$615,600
	Three-year total: $1,541,025		**Three-year present value: $1,252,929**		

TASK WORKER PRODUCTIVITY

HoloLens 2 enables users to see and manipulate advanced instructions, schematics, and other information overlaid on the real world while remaining heads-up and hands-free. They avoid back-and-forth referencing of instructions to improve efficiency and minimize risk, such as when working on ladders or in clean rooms. Workers also use remote collaboration apps to quickly get support from peers or experts.

In more advanced use cases, users can analyze, monitor, and stream data bidirectionally from the HoloLens 2 including its sensors, user inputs, and other data sources such as IoT sensors and ERP or patient record systems. This enables further improvements in work speed and efficiency, decision-making, work quality, and safety. Users can also use HoloLens 2 to input data directly into systems for recordkeeping to improve accuracy and compliance while saving time.

Ultimately, mixed reality helps workers be more efficient, avoid errors and damage, meet operational and customer needs faster, minimize health and safety risks, and work with more confidence.

Industry impact. Onsite task worker benefits are expressed uniquely by sector, including:

- **Manufacturers improved efficiency by 75% for 15% of onsite tasks and reduced rework by 50%, saving $30 per hour.** The complexity of workers' jobs in manufacturing continues to rise, as do the stakes and expectations. Mixed reality provided customers with detailed, accurate, and easily understood instructions and support to maximize ROI on high-value work.
- **AEC firms improved efficiency by 60% for 15% of onsite tasks and reduced rework by 50%, saving $44 per hour.** Complexity of work and expectations also drive high stakes for AEC firms, maximizing potential savings from MR.
- **Healthcare providers improved efficiency by 30% for 15% of onsite tasks, saving $41 per hour while also aiming to improve quality of care.** Healthcare workers used MR instructions, visualization, and remote collaboration to complete ward rounds more quickly and efficiently and reduce staff in rooms, boosting capacity in the face of staff shortages and overwhelmed systems while minimizing exposure to infectious diseases.
- **Education providers hope to improve efficiency of research with mixed reality.** Task work conducted as part of university research may be able to benefit from mixed reality for quality, efficiency, or data capture.

Evidence and data. Interviewees shared many examples of task work benefits, including:

- **A healthcare and education organization used HoloLens 2 to streamline clinical care by 30% while slashing PPE use by 80% and reducing risk of COVID-19 exposure.** The clinical scientist and professor shared: "We had teams of doctors supporting COVID wards, but by putting a HoloLens on one clinician, only one needed to go into the risky environment instead of three to five. We immediately reduced exposure risk and PPE consumption, while the teams could still see and understand what was happening and communicate effectively. Our rooms became 30% more efficient, and we reduced COVID exposures and PPE usage by 80%."
- **An aerospace manufacturer slashed task time by over 90% with instructions, visualization, and real-time data from sensors and IoT devices.** The X-reality principal investigator shared: "Using mixed reality, we've cut task time by about 90%. We reduced activities with two to three technicians working two to three days down to one technician in 2.5 hours. A separate eight-shift activity can be completed in about 6 hours. We've taken other 8-hour activities down to about 45 minutes. Overall, we're bringing times down significantly by 91% to 93%."

Mixed reality increased task efficiency by **60%** and reduced rework by **50%,** saving **$6,540** annually per onsite task worker.

Modeling and assumptions. Forrester modeled the impact for the composite organization assuming:

- The composite deploys 50 HoloLens 2 devices to company facilities that are shared among 120 task workers with an average utilization of 75%.
- Up to 15% of tasks are supported by mixed reality, which achieve a 60% efficiency increase.
- Ten percent of time is normally wasted on rework and issues; MR prevents 50% of this waste.

Risks. The expected financial impact is subject to risks and variation based on several factors:

- MR's ability to aid task work will vary by specific task and depend on the availability of remote experts and site conditions such as heat, sunlight, safety risks, and network connectivity.
- Achieving savings relies on building relevant and high-quality MR guides and/or models, for which the availability and cost of getting the right data to feed 3D models can be a significant inhibitor.
- Recaptured savings will depend upon the number of users reached and their average labor cost.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV of $1.4 million.

Task Worker Productivity

Ref.	Metric	Source	Year 1	Year 2	Year 3
C1	Typical task working hours per year, per task worker	Composite	1,560	1,560	1,560
C2	Percentage of tasks supported by MR	Interview data	7.5%	15%	15%
C3	Increase in task efficiency with MR	Interview data	60%	60%	60%
C4	Hours saved per task worker (rounded)	C1*C2*C3	70	140	140
C5	Percentage of task time used for rework	Interview data	10%	10%	10%
C6	Reduction in rework with MR	Interview data	25%	50%	50%
C7	Hours saved through MR quality per task worker	C1*C5*C6	39	78	78
C8	Hours saved per task worker	C4+C7	109	218	218
C9	Fully burdened hourly compensation for task workers	Payscale.com, multi-industry average	$30	$30	$30
C10	Labor cost saved per worker	C8*C9	$3,270	$6,540	$6,540
C11	Number of task workers	Composite	120	120	120
Ct	Task worker productivity	C10*C11	$392,400	$784,800	$784,800
	Risk adjustment	↓10%			
Ctr	Task worker productivity (risk-adjusted)		$353,160	$706,320	$706,320
	Three-year total: $1,765,800			**Three-year present value: $1,435,459**	

LEADER PRODUCTIVITY

Mixed reality helped leaders minimize instruction time, accelerate planning and design processes, streamline sales and customer support, reduce scheduling and capacity management, and avoid errors and delays that could lead to excess time spent in remediation. Leaders also looked to use mixed reality as one component of their broader future technology transformation plans.

Mixed reality recaptured **30%** of leaders' time for training, instruction, planning, project coordination, and customer enablement, saving **$15,600** annually per leader.

Industry impact. Leader productivity benefits are expressed uniquely by sector, including:

- **Manufacturers improved productivity by 30% for 50% of leaders' workloads, saving $43 per hour.** Manufacturing leaders reduced training effort, shortened project planning and design, minimized errors and delays, and reduced downtime with MR. Augmented leadership roles include plant, production, field service, and technical project managers.
- **AEC firms improved productivity by 35% for 50% of leaders' workloads, saving $55 per hour.** Construction and engineering leaders shortened design phases, gained faster buy-in, improved sales and customer enablement, minimized instruction, and prevented errors and delays to avoid wasted labor.
- **Healthcare providers improved productivity by 25% for 50% of leaders' workloads, saving $195 per hour.** Clinical site supervisors and other site and practice leaders reduced time needed for instruction and patient support while streamlining capacity and coordination for care.
- **Education providers improved productivity by 15% for 75% of leaders' workloads, saving $65 per hour.** Department and program leaders gained efficiencies through offloaded training; increased efficiency for conferences and collaboration; reduced department costs, helping budgeting; and improved student performance enabled by MR that assisted grant applications.

Evidence and data. Interviewees shared many examples of benefits to leaders, including:

- **A construction and engineering company used HoloLens 2 to align teams that were previously at odds.** The VP of design and engineering shared: "There are many ways to say the same thing and to do things in different regions, different parts of the country, and at partner companies. Without everybody sitting in front a map speaking the same vernacular, you really don't know what you're getting. Mixed reality is the one thing that everybody can understand and translate instantly because it's visualized in real space. There's less confusion and rework, with more concise action to achieve the goal. We're more efficient with our clients' time, money, and effort."
- **An electrical manufacturer streamlined leader workflows while boosting sales and reducing costs and labor.** Leaders used mixed reality visualization to gain customer buy-in, optimize plans to ensure deployment success, and shorten sales cycles. Self-guided training and instructions reduced active instruction time for leaders, and remote collaboration boosted efficiency when their insight was needed. Mixed reality further prevented errors and reduced customer-impacting issues, preventing leaders from spending time rectifying problems.

- **A healthcare and education provider scaled care and training with improved operations.** Leaders streamlined management, contingency training, instruction, planning, budgeting, and grant writing with MR. Leaders also tapped mixed reality as they scrambled to enable remote education and observation during the pandemic. Looking forward, leaders saw the potential of MR to shape the future of healthcare, as the clinical scientist and professor shared: "Mixed reality fits in the evolution and reconceptualization of healthcare systems as we recover from COVID-19. It will be part of the future vision of digital healthcare and pathways of care as we investigate redistributing diagnostic centers, pushing care out of hospitals into the community, and scaling and distributing specialist services."

Modeling and assumptions. Forrester modeled the impact for the composite organization assuming:

- Leaders typically dedicate half their time to tasks that benefit from MR rollout, including training, instruction, project coordination, planning, and customer enablement.
- Mixed reality offloads work, streamlines processes, and reduces issues needing attention to reduce this time spent by 30%.
- The composite employs 15 leaders who oversee teams of task workers and experts using MR.

Risks. The expected financial impact is subject to risks and variation based on several factors:

- The percentage of training and work tasks for which MR is deployed and the degree to which it improves processes.
- The type of leadership roles and particular breakdown of their work responsibilities.
- Recognizing savings is contingent on building relevant and high-quality MR functionality.
- Recaptured savings will depend upon the number of users reached and their average labor cost.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV of $428,000.

Leader Productivity

Ref.	Metric	Source	Year 1	Year 2	Year 3
D1	Typical hours per leader for training, instruction, project coordination, planning, and customer enablement	Composite	1,040	1,040	1,040
D2	Increase in recaptured labor for these tasks with MR	Interview data	15%	30%	30%
D3	Hours saved per lead with MR	D1*D2	156	312	312
D4	Fully burdened hourly compensation for leaders	Payscale.com, multi-industry average	$50	$50	$50
D5	Labor cost saved per lead	D3*D4	$7,800	$15,600	$15,600
D6	Number of project, program, or site leaders/managers	Composite	15	15	15
Dt	Leader productivity	D5*D6	$117,000	$234,000	$234,000
	Risk adjustment	↓10%			
Dtr	Leader productivity (risk-adjusted)		$105,300	$210,600	$210,600
	Three-year total: $526,500			**Three-year present value: $428,004**	

SPECIALIZED EXPERT PRODUCTIVITY

Specialized experts are employees or contractors with rare expertise (i.e., seniormost engineers, professors, or surgeons), providing business-critical work and playing key roles in training. MR helps experts offload mundane or repetitive work to task workers with virtual work instructions and training. Experts use MR remote support for critical needs to avoid travel, boost capacity, and address needs more efficiently. Further, advanced MR visualizations and bidirectional sensor feeds enable experts to improve the speed, quality, and effectiveness of their work.

Mixed reality increased expert work efficiency by **30%** and prevented **75%** of major trips, saving **$58,512** in annual labor costs per specialized expert.

Industry impact. Expert productivity benefits are expressed uniquely by sector, including:

- **Manufacturers and AEC firms both reduced 1,040 annual hours of training and task work per expert by 35%; they also prevented 75% of monthly trips with 90% of labor per trip avoided, saving $92 per hour.** A sizable portion of manufacturing and AEC expert workloads is addressable with MR. Further, travel is a particularly large portion of their jobs; however, it can often be easily avoided with better task worker training, instructions, and remote guidance only when needed.
- **Healthcare providers reduced 520 annual hours of training per expert by 10% and prevented two out of four trips per year with 75% of labor per trip avoided, saving $195 per hour.** Healthcare experts rely less on process standardization and cannot offload work easily, although MR still drives benefits at the margins. Travel is infrequent, but savings are significant especially due to large average salaries.
- **Education providers reduced 520 annual hours of instruction per expert by 15% and prevented two out of four trips per year with 75% of labor per trip avoided, saving $58 per hour.** Educators have slightly more standardized work that can be addressed with MR than those in healthcare; however, travel remains infrequent and cost savings are lower due to their salaries.

Evidence and data. Interviewees shared many examples of expert productivity benefits, including:

- **An education organization used self-guided instruction to shift professors' time for more advanced content and enabled remote instruction during the pandemic.** The associate dean of professional and graduate programs shared: "Students need to know how to do both basic and advanced work. University faculty are well-trained PhD scientists, so it's a better use of experts' time to focus on advanced content. Students can instead learn the basics through MR instructions. For one skill, we reduced lab time from many hours to just 30 minutes with MR and allowed students to practice without restricted time or cost." The associate dean continued, "When the world closed and it became clear we couldn't execute in-person labs, we looked to HoloLens with Remote Assist to supplement and keep the coursework running."
- **A healthcare provider and education organization enabled crucial remote patient care during the pandemic.** The doctor and chief clinical information officer shared: "We were looking to avoid nonessential travel and infection contact for patients and practitioners. HoloLens 2 supported remote visual patient assessment with access to electronic records and promoted confidence and reassurance for families."

- **An automotive manufacturer saved expert time and costs with remote support of field staff.** The IT X-reality leader shared: "With [Remote Assist on] HoloLens, we can extend our eyes and environment to someone who isn't there. We can show the expert the exact area with a problem and the screens they need to see, instead of just describing it."

Modeling and assumptions. Forrester modeled the impact for the composite organization assuming:

- The composite employs 15 experts who support the global business and earn $92 per hour.
- Experts spend half their time supporting training and local task work, which MR reduces by 30%.
- Experts travel globally 12 times per year and spend 40 hours per trip. MR prevents 75% of trips, saving 90% of labor hours per avoided trip.

Risks. The expected financial impact is subject to risks and variation based on several factors:

- The role of experts, the tasks they support, and the frequency and distance of their travel.
- The scope, quality, and adoption of instructions and remote assistance to task workers with MR.
- The number of experts affected and their average annual salary and travel costs.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV of $1.6 million.

Specialized Expert Productivity

Ref.	Metric	Source	Year 1	Year 2	Year 3
E1	Hours spent on training, instruction, and local task work that can be aided by MR per year, per expert	Composite	1,040	1,040	1,040
E2	Increase in recaptured efficiency with MR	Interview data	15%	30%	30%
E3	Hours saved with MR training, instructions, and local remote support per expert	E1*E2	156	312	312
E4	Major trips per expert, per year	Composite	12	12	12
E5	Average labor hours per trip	Composite	40	40	40
E6	Percentage of major trips that can be remote with MR	Interview data	33%	75%	75%
E7	Percent reduction in labor with MR	Interview data	90%	90%	90%
E8	Hours saved by avoiding major trips per expert (rounded)	E4*E5*E6*E7	143	324	324
E9	Hours saved per expert	E3+E8	299	636	636
E10	Fully burdened hourly compensation for specialized experts	Payscale.com, multi-industry average	$92	$92	$92
E11	Labor cost saved per expert	E9*E10	$27,508	$58,512	$58,512
E12	Number of specialized experts	Composite	15	15	15
Et	Specialized expert productivity	E11*E12	$412,620	$877,680	$877,680
	Risk adjustment	↓10%			
Etr	Specialized expert productivity (risk-adjusted)		$371,358	$789,912	$789,912
	Three-year total: $1,951,182			**Three-year present value: $1,583,891**	

TRAVEL AND INCIDENTALS SAVINGS

Replacing expert travel with remote expertise and self-guided task worker instruction saves significant travel and incidentals costs (flights, cars, hotels, food and beverage, etc.) in addition to labor saved. Costs saved are typically between $1,000 and $6,000 (and sometimes much higher) per trip, with a typical savings of $3,500. Avoided regional field worker trips for rework and follow-up visits also generate minor cost savings for fuel and incidentals.

Mixed reality reduced annual travel and incidentals costs by **$31,500** for specialized experts and by **$2,950** for field task workers.

Industry impact. Travel and incidentals savings are expressed uniquely by sector, including:

- **Manufacturers saved an average of $3,500 per avoided expert trip and $50 per avoided field worker trip.** Expert travel for manufacturers was excessively expensive (ranging between $1,000 to $7,000 per trip) for several reasons: Trips were often booked last-minute to address major issues; trips were often to far-flung international sites or remote locales; and experts typically flew first class given their seniority and the wearing nature of these frequent major trips.
- **AEC firms saved an average of $2,000 per avoided expert trip and $50 per avoided field worker trip.** Expert travel at AEC firms was less expensive and was less likely to require last-minute booking and major international travel, as experts were more commonly located domestically as compared to their destination given the regional nature of many AEC firms.
- **Healthcare providers saved an average of $4,500 per avoided expert trip.** Expert travel in healthcare was particularly expensive, as it often involved multiweek international affairs for very senior employees; however, travel was much less common in healthcare than in manufacturing or AEC, and therefore, total expert cost savings are actually lower for the industry in total.
- **Education providers saved an average of $2,500 per avoided expert trip.** Expert travel costs were lower than average in education as experts typically booked further in advance and did not fly first class, and experts often did not travel nearly as frequently as those in manufacturing or AEC. However, education organizations may see particularly significant variation depending upon the expert's role and the institution's scale.

> **"We have less boots on the ground but the same impactfulness."**
>
> *Innovation portfolio manager, automotive manufacturing*

Evidence and data. Interviewees shared many examples of these savings, including:

- **An education organization saved $50,000 in average annual travel costs per professor and expects to permanently reduce trips by 50% with HoloLens 2.** Some experts traveled almost 200,000 miles per year, driving large savings by using mixed reality without sacrificing the research and collaboration value of the trips. Cost savings were particularly important in academia due to funding limitations, as the associate dean of professional and graduate programs shared: "We're all poor in the academic space. Using the HoloLens to interact with colleagues across the globe is way cheaper than flying there for two weeks and staying in a hotel — let alone the effects long trips have on your body and family."

- **All manufacturers significantly reduced travel costs with mixed reality instructions and remote assistance.** The electrical manufacturer avoided between two and 15 visits per site per week. Each session now requires 30 to 60 minutes, whereas it used to cost at least three days of labor at €600 to €800 per day and as much as €6,000 in travel costs. Similarly, the automotive manufacturer avoided at least three days of labor and an average of €5,000 in travel costs per issue. Even when experts are based at the same site, the aerospace manufacturer found significant time savings by not having to wait for the expert to be free, get to the production line, and suit up for clean rooms.

Modeling and assumptions. Forrester modeled the impact for the composite organization assuming:

- Up to 59 trips are avoided per field worker per year for 50 workers at an average cost of $50.
- Up to 9 trips are avoided per expert per year for 15 experts at an average cost of $3,500.

> **"HoloLens with Remote Assist is a no-brainer. We want to buy two for every plant. They pay for themselves in no time at all, and then it's all benefits from there. It pays for itself in just travel costs alone."**
>
> *Innovation product director, power manufacturing*

Risks. The expected financial impact is subject to risks and variation based on several factors:

- The scope, quality, and adoption of MR.
- The number of experts and field workers affected and their frequency of trips.
- The typical distance, length, tier, and amount of advance notice of avoided trips for experts.
- The typical travel cost and incidentals incurred per field worker trip.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV of $1.1 million.

Travel And Incidentals Savings

Ref.	Metric	Source	Year 1	Year 2	Year 3
F1	Avoided trips per field worker (rounded)	B1*B5*B6/2 hours per trip	30	59	59
F2	Average travel and incidentals cost per field worker trip	Interview data	$50	$50	$50
F3	Cost savings per field worker	F1*F2	$1,500	$2,950	$2,950
F4	Total cost savings for field workers	B11*F3	$75,000	$147,500	$147,500
F5	Avoided trips per expert (rounded)	E4*E6	4	9	9
F6	Travel cost, lodging, and incidentals per expert trip	Interview data	$3,500	$3,500	$3,500
F7	Cost savings per expert	F5*F6	$14,000	$31,500	$31,500
F8	Total cost savings for experts	E12*F7	$210,000	$472,500	$472,500
Ft	Travel and incidentals savings	F4+F8	$285,000	$620,000	$620,000
	Risk adjustment	↓10%			
Ftr	Travel and incidentals savings (risk-adjusted)		$256,500	$558,000	$558,000
	Three-year total: $1,372,500			**Three-year present value: $1,113,573**	

OPERATIONAL COST SAVINGS

Mixed reality helped organizations across sectors reduce operational expenses beyond travel savings.

- **MR training and instructions allowed users to learn and practice while minimizing or eliminating usage of consumable supplies.** Examples include chemicals, compounds, raw materials, paper, parts, tools, prototyping and 3D printing materials, shipping, packaging, fuel, cleaning supplies, and mannequins. Organizations also reduced other costs such as training travel and the construction and operation of physical training spaces (including site rental costs, HVAC, energy, janitorial, and beyond).
- **MR training and instructions allowed companies to avoid creating, shipping, and continually updating physical instruction manuals and models.** The ability to provide regular updates and localization further reduced costs while enabling more frequent updates.
- **MR visualization enabled organizations to replace physical prototyping, demonstration, and testing.** Leaders, experts, and salespeople achieved significant cost savings to fabricate, update, and demonstrate models in both consumable materials and shipping.
- **MR reduced PPE consumption for all use cases that drove efficiency, reduced trips, or minimized onsite users.** PPE included health protection for infectious diseases like COVID-19 and environmental protection for clean rooms and hazardous work sites.
- **MR improved quality, prevented errors and rework, accelerated MTTR, and reduced downtime and delays to save net operational costs.** Organizations reduced wasted materials and spoilage, wasted labor and overtime, excess materials and parts usage, premium freight and rush-shipping costs, excess fuel costs, noncompliance costs, and warranty claims.

Industry impact. Operational cost savings are expressed uniquely by sector, including:

- **Manufacturers derived dependable consumables and operating cost savings with MR investments.** Companies reduced: 1) average consumables costs of $1,000 per trainee by 80%; 2) average consumables costs for design, testing, and demonstration of $150,000 per expert and leader by 10%; 3) average annual PPE costs per user of $268 by 50%; and 4) operating costs by 0.14% versus baseline costs of 92% of revenue.
- **AEC firms further reduced operating costs and consumables with MR investments.** Firms reduced: 1) average consumables costs of $1,000 per trainee by 80%; 2) average consumables costs for design, testing, and demonstration of $200,000 per expert and leader by 10%; 3) average annual PPE costs per user of $268 by 50%; and 4) operating costs by 0.3% versus baseline costs of 95.9% of revenue.
- **Healthcare providers reduced PPE and consumables costs by the most but found lower operating margin savings overall.** Organizations reduced: 1) average consumables costs of $5,000 per trainee by 80%; 2) average consumables costs for design, testing, and demonstration of $100,000 per expert and leader by 10%; 3) average annual PPE costs per user of $1,272 by 75%; and 4) operating costs by 0.1% versus baseline costs of 95% of revenue.
- **Education providers achieved the highest operating cost reductions via lab and consumables efficiencies.** Organizations reduced: 1) average consumables costs of $5,000 per trainee by 80%; 2) average consumables costs for design, testing, and demonstration of $150,000 per expert and leader by 10%; 3) average annual PPE costs per user of $268 by 75%; and 4) operating costs by 0.5% versus baseline costs of 90.7% of revenue.

Mixed reality minimized consumables usage by **80%** for instruction and training; materials costs by **10%** for design, testing, and enablement; and PPE usage by **60%** per user.

Evidence and data. Interviewees shared many examples of operational cost savings, including:

- **A manufacturing company in the power sector reduced rework waste by 90%, avoided expensive delays and issues, and cut expert trips by 10% — driving a per-device payback period of only 4.9 months.** The company found significant savings by accelerating work and preventing and mitigating issues. It avoided materials waste and wasted labor (or overtime) during production stoppages, premium and rush freight to make up for delays, and noncompliance costs and warranty claims caused by issues, errors, or delays.
- **A construction and engineering company evaluated and revised designs early with MR to avoid rework and control costs.** Every clash or flaw they identified saved thousands of dollars in costs plus labor savings, while also preventing delays and improving CX. The corporate controls manager shared: "We went out to job sites, loaded models in the HoloLens, and let team members walk around. On every site, we saw opportunities to change designs and installation plans to be faster and better and found clashes and issues between model components and infrastructure. Every instance saves us several thousand dollars, and without this technology, we would not identify issues until actually installing work in the field. This is when the ROI hit home how valuable mixed reality is."
- **A healthcare and education organization projects long-term cost savings with HoloLens 2.** The surgeon and medical education director shared: "We see this as a portable computer with a holographic visor. It's not a pure use case device — it's an infrastructure investment for the entire hospital. This will drive cost savings because it's not a machine for a specific purpose; rather, it can be used for essentially anything within the hospital."
- **An education organization projects that HoloLens 2 will improve work quality to reduce the cost and impact of waste in life sciences.** The associate dean of professional and graduate programs shared: "Improving productivity is good, but it's even better to improve the quality of work with better training and work instructions. That way we won't have to throw away as many batches of a drug and waste those costs. We could avoid the environmental downsides, too."

Mixed reality trimmed total business operating costs by **0.2%** through better processes, quality, and maintenance.

Modeling and assumptions. Forrester modeled the impact for the composite organization assuming:

- The composite trains 500 to 1,000 employees per year with a typical cost of $1,000 in consumable training resources. MR reduces cost by 80%.
- The composite's 30 leaders and experts spend $150,000 per year for design, testing, and enablement. MR reduces cost by 10%.
- Up to 1,200 total users interact with MR, reducing per-user PPE costs of $268 by 60%.[5]

- The composite deploys MR in a business unit that generates $250 million per year in revenue with an operating profit margin of 6.5%. MR reduces operating costs by 0.2%.

Risks. The expected financial impact is subject to risks and variation based on several factors:

- Scope, adoption, and quality of MR applications.
- Number of users, their roles, and the associated cost of materials and PPE for the work they do.
- Level of process rigor before and with MR.
- Actual operating costs dependent upon business unit, sector, region, and specific offerings.

Results. To account for these risks, Forrester adjusted this benefit downward by 15%, yielding a three-year, risk-adjusted total PV of $2.9 million.

Operational Cost Savings

Ref.	Metric	Source	Year 1	Year 2	Year 3
G1	Number of annual trainees	A6	500	750	1,000
G2	Per-user consumables cost, instruction, and training	Interview data	$1,000	$1,000	$1,000
G3	Avoided consumables with MR training and instruction	Interview data	40%	80%	80%
G4	Training and instruction cost savings	G1*G2*G3	$200,000	$600,000	$800,000
G5	Number of leaders and experts	D6+E12	30	30	30
G6	Average consumables cost per leader/expert for design, testing, demonstration, and enablement	Interview data	$150,000	$150,000	$150,000
G7	Avoided consumables with MR	Interview data	5%	10%	10%
G8	Training and instruction cost savings	G5*G6*G7	$225,000	$450,000	$450,000
G9	Total MR users, including trainees and device sharing	A6+B11+C11+D6+E12	700	950	1,200
G10	Estimated annual cost of PPE per employee (cost for pandemic period after March 2020)	UC Berkeley Labor Center	$268	$268	$268
G11	Percent reduction in needed PPE using MR	Interview data	30%	60%	60%
G12	PPE cost savings	G9*G10*G11	$56,280	$152,760	$192,960
G13	Total revenue generated by business units utilizing MR	Composite	$250 million	$250 million	$250 million
G14	Operating costs as a percentage of revenue	Stern School of Business, NYU	93.5%	93.5%	93.5%
G15	Reduction in operating costs from avoided rework, waste, and streamlined processes using MR	Interview data	0.1%	0.2%	0.2%
G16	Operating costs saved using MR	G13*G14*G15	$233,750	$467,500	$467,500
Gt	Operational cost savings	G4+G8+G12+G16	$715,030	$1,670,260	$1,910,460
	Risk adjustment	↓15%			
Gtr	Operational cost savings (risk-adjusted)		$607,776	$1,419,721	$1,623,891
	Three-year total: $3,651,388			**Three-year present value: $2,945,900**	

BUSINESS GROWTH

Organizations across sectors bolstered sales with HoloLens 2. They increased customer interest and buy-in by using mixed reality to visualize plans and positioning themselves as experts that leverage leading-edge technology. MR teams from care providers to production lines to installation and support increased capacity to fulfill more business. Customers helped ensure operational continuity with mixed reality, helping to reduce the risk of potential losses due to business disruption (such as during the COVID-19 pandemic). Mixed reality also improved CX, quality of service, and educational outcomes — further driving customer interest and retention.

Business units leveraging mixed reality increased annual revenue by **4%.**

Industry impact. Business growth benefits are expressed uniquely by sector, including:

- **Manufacturers and AEC firms increased revenue by up to 5% with mixed reality.** MR boosted sales by increasing throughput and reducing downtime for manufacturers and by accelerating project timelines and opening work capacity for AEC firms. MR accelerated customer deployments and enhanced support, boosting CX and therefore retention and enrichment. MR also strengthened brand image to recruit prospects and assisted salespeople in closing deals. Firms also generated new revenue streams by offering and packaging new MR-enabled services.
- **Healthcare providers increased revenue by up to 1% with mixed reality.** Providers increased capacity to care for more patients, ensured continuity during the pandemic, and bolstered image with leading-edge technology. They were working to develop and commercialize custom healthcare applications to drive new revenue.

> **"Salespeople love to be at a company where they can use cutting-edge HoloLens technology to convince a customer. Demonstrating [plans with mixed reality] makes the sales process much easier."**
>
> *Digital transformation leader, electrical manufacturing*

- **Education providers hope to increase program demand, and therefore, revenue.** Interviewees believed that leading-edge MR technology made programs more prestigious and compelling to prospective students, driving competitive advantage. Educators improved learners' knowledge acquisition and retention with MR, improving learning outcomes. Students also learned to use this leading-edge technology. Interviewees believe this will drive better career placement and career success for students, increasing program competitiveness.

Evidence and data. Interviewees shared many examples of business growth benefits, including:

- **A construction and engineering company used HoloLens 2 to enable sales by gaining buy-in with customers.** The VP of design and engineering shared: "We're seeing HoloLens as a good sales tool. It visualizes plans for people who aren't tech savvy. It also reduces the costs of projects. Mixed reality has definitely translated into more work. I can't think of any client that we've utilized the HoloLens with that we've lost as a client. We only gained opportunities and ended up doing more and more work with them."
- **An education provider recruited students with HoloLens 2.** The executive director of innovation shared: "Many students are choosing our program because it is innovative. We have amazing student testimonials explaining how valuable [MR instruction] was to clearly see and understand materials and continue their learning. The students are very passionate about it."

- **Manufacturers increased throughput and capacity, driving increased sales and accelerating time-to-revenue.** Firms avoided 240 to 320 hours in average lost throughput per year by using mixed reality to improve training, reduce errors, and solve issues more quickly. Field staff also recaptured their efficiency savings to complete more customer deployments and service appointments per worker.

"Mixed reality helps sell our value as a great company to work with because we bring technology like HoloLens to the table. It saves money for us and for our clients and strengthens our relationships."

Corporate controls manager, construction and engineering

Modeling and assumptions. Forrester modeled the impact for the composite organization assuming:

- The composite deploys MR in a business unit that generates $250 million per year in revenue with an operating profit margin of 6.5%.
- Mixed realty protects and increases revenue totaling 4% of the business unit's annual value.

"We use HoloLens to recruit students into our life sciences program. Mixed reality is an important skill for our students to bring to the workforce and know how to use when they go to work. This technology does help attract students."

Associate dean of professional and graduate programs and head of center of excellence, education

Risks. The expected financial impact is subject to risks and variation based on several factors:

- Business unit revenue and profit margins will vary per company and use case.
- Business growth is affected by a complex web of factors such as market dynamics, natural and geopolitical disruptions, product developments, competition, pricing, and reputation.
- Business growth enabled by mixed reality can be very difficult to measure and prove attribution.
- The scope, adoption, and quality of MR investments will affect benefit recognition.

Results. To account for these risks, Forrester adjusted this benefit downward by 20%, yielding a three-year, risk-adjusted total PV of $1.1 million.

Business Growth

Ref.	Metric	Source	Year 1	Year 2	Year 3
H1	Total revenue generated by business units utilizing MR	Composite	$250,000,000	$250,000,000	$250,000,000
H2	Increased or protected incremental revenue attributable to MR	Interview data	2.0%	4.0%	4.0%
H3	Revenue growth attributable to MR	H1*H2	$5,000,000	$10,000,000	$10,000,000
H4	Operating profit margin	1-G14	6.5%	6.5%	6.5%
Ht	Business growth	H3*H4	$325,000	$650,000	$650,000
	Risk adjustment	↓20%			
Htr	Business growth (risk-adjusted)		$260,000	$520,000	$520,000
	Three-year total: $1,300,000			**Three-year present value: $1,056,799**	

QUALITATIVE BENEFITS

In addition to the financially quantifiable benefits listed above, mixed reality solutions leveraging Microsoft HoloLens 2 also helped organizations achieve the following qualitative or unique outcomes:

- **Enhanced employee experience.** Employees' ability to make progress toward their work is one of the top drivers of EX.[6] Consequently, mixed reality significantly increased employees' excitement and satisfaction in their jobs. It also helped prevent overtime and last-minute travel, helping employees find a comfortable work-life balance. Employees also learned more skills and retained knowledge better, enabling further career growth. Employees became stronger advocates for their employer, were more likely to be retained, and were more likely to take part in innovation. The power manufacturer's innovation product director shared: "We are seeing universal acceptance [of mixed reality with HoloLens]. Our [Net Promoter Score℠] from users was stunningly good. Over the last eight months, only one user was a detractor with all others as a high neutral or a promoter. We did not expect NPS to be that high or [to see] that level of universal acceptance."[7]
- **Improved ability to attract, hire, and retain employees.** Organizations faced labor shortages and lost expertise due to aging workforces; the COVID-19 pandemic, and the 2021 bubble of resignations.[8] Mixed reality helped combat brain drain by capturing senior employees' expertise in virtual instructions for effective new hire training, while also enabling organizations to hire less-experienced employees. Further, the use of workforce-enabling MR technology made organizations more attractive as employers to both current employees and prospective job seekers. In aggregate, organizations could better ensure sustainability of services while and reduce the risk and cost of employee hiring.
- **Protected health and safety.** Mixed reality trainings and work instructions were more comprehensive and effective, helping improve adoption of proper safety protocols while ensuring that work was completed correctly and safely. Working heads-up and hands-free with minimal back and forth reduced safety risks, though proper spotting was crucial in dangerous scenarios. Faster task completion with fewer people onsite reduced both the number of people exposed and the duration of exposure to hazards such as falling objects or COVID-19. Fewer air and road miles logged further reduced workers' exposure to dangers. Protecting health and safety most importantly benefited employees' well-being, but also had the side effects of improving EX; enhancing brand image; and minimizing costs for insurance, claims, and hazard pay.
- **Bolstered disaster preparedness and business continuity.** Ensuring continuity of operations and service is critical to both bottom- and top-line business performance. Mixed reality enabled organizations to provide immediate support to company sites and customers in need via remote assistance and self-guided instructions. Using MR, workers or customers without expertise could deploy equipment, learn to perform critical tasks, or fix issues without needing to wait for help to physically arrive (which the pandemic sometimes rendered impossible). All industries benefited: Healthcare organizations could get support to set up, maintain, and use medical devices or get specialist expertise for a new condition; educational institutions could deploy and fix key lab equipment or help a researcher complete work; manufacturers could fix production-stopping or dangerous issues at company or customer sites; and AEC firms could help onsite teams diagnose issues and effectively complete work without delay.

- **Ensured compliance.** Organizations were able to reduce the time and cost to complete inspections and audit lifecycles, while also increasing audit frequency. Teams could use data capture and recording in HoloLens 2 to better track and prove compliance.
- **Furthered sustainability goals.** Mixed reality helped organizations reduce their environmental impact by obviating travel, reducing rework and errors, and minimizing use of consumables and PPE. An educational institution's associate dean of professional and graduate programs shared: "We can do a bunch of training and not use any reagents. Those reagents aren't friendly to anyone — people or the environment. Similarly, in a manufacturing scenario, you could avoid wasting a few metal plates or shipping some additional supplies. Avoiding or reducing use of materials, especially chemicals, can reduce risk of exposure and environmental impact."
- **Enhanced outcomes for customers, patients, and students.** Mixed reality enabled organizations to provide better outcomes in a myriad of scenarios beyond those that could be directly quantified. Manufacturers and AEC firms were able to reduce costs for customers and accelerate deployments and service, helping customers themselves gain faster time-to-value and greater returns from their investment in the manufacturer or AEC firm's offering. Healthcare providers were able to meet patients' needs faster and consult others for further advice, improving experience and aiming to deliver better care outcomes. Education providers improved learning speed and knowledge acquisition while improving the student experience, helping students be more prepared and effective as they entered the workforce.

Voice Of The Customer

"The value of mixed reality is pretty huge, even if you just think about the capabilities in just Guides and Remote Assist and the amount of time that can be saved in teaching and research. I envision scenarios where a professor is traveling across the world and the postdoc needs to do something, and they can just put on the headset and walk through it together to solve a problem in minutes and move research forward rather than wait weeks."
— Associate dean of professional and graduate programs and head of center of excellence, education

"The mixed reality solutions from Microsoft are really great. … I'm very happy with it. It was so convincing to get it running with a very lean production and really have a chance to improve processes. And there's no drawback I see with HoloLens. I'm very convinced of this technology, just like our company is."
— Digital transformation leader, electrical manufacturing

"I am completely convinced that mixed reality has a critical part to play in healthcare. I believe it's going to grow exponentially. It will be a vital tool in the clinician's armory with real applications, where it's going to have a really, really big impact. I honestly can't think of a clinical specialty where it wouldn't be useful."
— Clinical scientist and professor, healthcare provider and education

FLEXIBILITY

The value of flexibility is unique to each customer. Investing in mixed reality solutions built for Microsoft HoloLens 2 can open the door to myriad possible future investments and use cases that could drive further value for customers. Customers are considering using mixed reality to:

- **Monetize custom MR applications, scenarios, and expertise.** Many interviewees were first movers for a variety of use cases, custom-developing never-before-seen scenarios and instructions. Reselling these applications or the use case IP to other organizations could generate new revenue streams (like an ISV). Organizations could also monetize their expertise by providing MR consulting to other organizations in their sector (like an SI).
- **Launch new customer support offerings.** Some manufacturers are building customer support programs in which they will bundle HoloLens 2 devices with their products that include instructions and remote support, generating revenue and providing another level of support that enables more self-service along with expedient remote expert assistance.
- **Deploy and integrate MR with Microsoft Dynamics 365 Field Service, Microsoft Mesh, or other solutions.** Integrating mixed reality with back-office technologies such as ERP or CRM or with IoT sensors could significantly enhance value to workers and to data collection and analysis.
- **Deploy MR to additional departments and roles.** Other organizational functions like facilities, internal IT, and dedicated marketing and sales channels could find significant value in mixed reality adoption.
- **Innovate at the leading edge.** Putting new technology in the hands of employees can drive brilliant and unexpected innovations.
- **Redesign business processes and enhance decision-making by analyzing MR device and application data.** Arming frontline workers with devices has the added benefit of enabling data collection and tracking. This could help organizations evaluate ways to improve their processes to enhance outcomes, increase efficiency, or help them make better data-backed decisions.
- **Conduct mixed reality student examinations.** Interviewees are investigating the use of remote collaboration apps and scenario-based instructions to set up tests to evaluate user comprehension and ability to demonstrate skills.
- **Enhance clinical care.** Organizations are beginning to investigate how HoloLens 2 and mixed reality can be used to provide better medical care. Interviewees shared a remarkable breadth of scenarios they are currently testing, which offer significant potential to improve patient outcomes. Key use cases under investigation include visualization of scans and procedures and remote support for clinical emergencies or collaborative diagnoses. Organizations are also investigating using MR to educate patients to improve comprehension and informed consent. The scenarios currently being tested span many clinical segments, and interviewees have already made surprisingly notable achievements in their testing. However, until these scenarios and HoloLens 2 devices are both approved for the relevant usage by governmental bodies, they cannot begin formally driving value. Though these efforts and outcomes remain exploratory today, the future appears closer than many have anticipated.

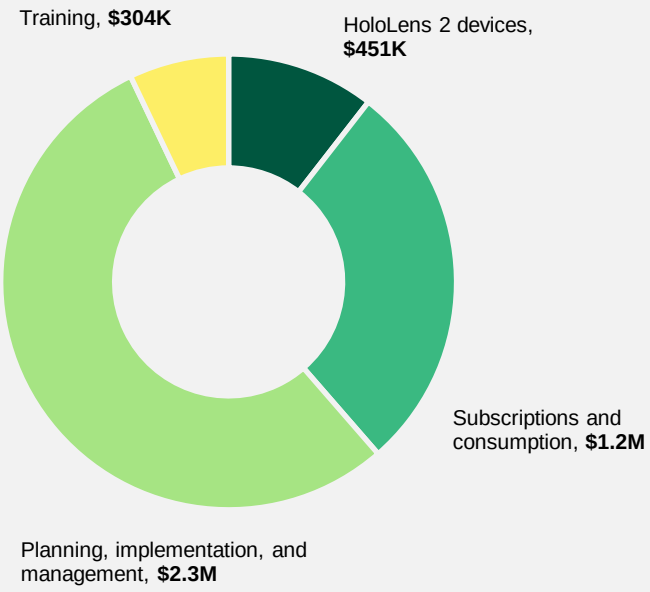
Flexibility would also be quantified when evaluated as part of a specific project (described in more detail in Appendix A).

Analysis Of Costs

Quantified cost data as applied to the composite

Total Costs							
Ref.	**Cost**	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Total**	**Present Value**
Itr	HoloLens 2 devices	$385,875	$7,938	$27,232	$46,526	$467,570	$450,552
Jtr	Subscriptions and consumption	$11,000	$448,800	$481,800	$514,800	$1,456,400	$1,203,959
Ktr	Planning, implementation, and management	$1,077,228	$676,798	$402,477	$402,477	$2,558,980	$2,327,511
Ltr	Training	$0	$203,280	$66,880	$84,480	$354,640	$303,544
	Total costs (risk adjusted)	$1,474,103	$1,336,816	$978,389	$1,048,283	$4,837,590	$4,285,566

Costs (Three-Year)



Costs overview. Forrester's model for the composite organization is a conservative representation of the total costs incurred by interviewees' organizations, adjusted relative to organization size, industry, and use cases. Learn more about the composite organization and Forrester's methodology for this study.

Unlike benefits, which vary significantly by industry, costs more consistently depend upon the selected apps, level of customization, and amount of content that needs to be created given the scale of the mixed reality deployment. Similar-scale deployments may have more similar costs across industries, even as the scale of benefits and how the benefits are realized may vary dramatically.

HOLOLENS 2 DEVICES

Evidence and data. Customers may purchase HoloLens 2 devices directly from Microsoft or through a partner. Devices can be dedicated per user or shared by multiple users. Some organizations may require specialized devices such as the Industrial Edition or third-party hard hat options.

Modeling and assumptions. Forrester modeled the cost for the composite organization assuming:

- The composite purchases 105 HoloLens 2 devices: five for development, 50 for field workers, and 50 to be shared at company sites by task workers, leaders, and experts.

"The HoloLens device design is great. It doesn't require cables [or] backpacks and doesn't get hot at points of skin contact. You don't get motion sickness with these displays, and it has the best capabilities around."

Digital transformation leader, electrical manufacturing

"The second-generation HoloLens 2 headset is definitely an improvement in ergonomics, weight, comfort, and technical capabilities. We've been really enjoying using it."

Clinical scientist and professor, healthcare provider and education

- HoloLens 2 devices cost $3,500 each. Overhead to replace up to 10% of devices annually is built in. Mobile device management (MDM) costs via Microsoft Intune are $6 per device, per month. The composite had previously deployed Microsoft Active Directory for users and Intune for MDM.

Risks. Forrester uncovered low risks that may impact device costs, including the selected use cases, number of sites and users, travel and site damage risk, network integration needs, device availability, existing usage of Microsoft services, and any need for specialized Industrial Edition or hard hat devices.

Results. To account for these risks, Forrester adjusted this cost upward by 5%, yielding a three-year, risk-adjusted total PV of $451,000

HoloLens 2 Devices

Ref.	Metric	Source	Initial	Year 1	Year 2	Year 3
I1	Total number of HoloLens 2 devices	Composite	105	105	105	105
I2	Cost per HoloLens 2 device	List pricing	$3,500	$3,500	$3,500	$3,500
I3	Initial device purchase costs	I1*I2	$367,500			
I4	Overhead for device replacements	Interview data		0%	5%	10%
I5	Device replacement costs	I1*I2*I4		$0	$18,375	$36,750
I6	Mobile device management subscription per device, per month	List pricing		$6	$6	$6
I7	MDM subscriptions	I1*I6*12		$7,560	$7,560	$7,560
It	HoloLens 2 devices	I3+I5+I7	$367,500	$7,560	$25,935	$44,310
	Risk adjustment	↑5%				
Itr	HoloLens 2 devices (risk-adjusted)		$385,875	$7,938	$27,232	$46,526
	Three-year total: $467,570			**Three-year present value: $450,552**		

SUBSCRIPTIONS AND CONSUMPTION

Evidence and data. Most mixed reality apps from Microsoft and ISV partners are priced using a per-user subscription fee, with additional costs incurred for Azure services consumption. Device-based licensing is an option for only some applications. The cost of custom-developed apps is instead based on internal and SI labor rather than subscriptions.

Modeling and assumptions. Forrester modeled the cost for the composite organization assuming:

- The composite leverages prebuilt apps that provide capabilities for instructions, visualization, and remote collaboration. The exact apps are not specified. Apps cost $1,600 in subscription costs per user, based on blended average of costs for both Microsoft and ISV applications.
- The composite assigns subscriptions to 200 end users at a ratio of one user per 50 field devices and three users per 50 onsite devices. Five more subscriptions are used for the innovation team. Trainees using MR leverage user accounts that are continually reassigned per cohort from the slate of 150 accounts for the 50 onsite devices.
- The composite incurs Azure costs of up to $120,000 per year, growing as usage of the applications increases over time.
- The composite incurs up to $20,000 in additional costs to provide network connectivity for sites or field users without dependable access.

Risks. Costs will vary based on the selected applications and number of users. Interviewees noted that their largest inhibitor to scaling MR was user-based licensing models that became prohibitively expensive and difficult to manage for large numbers of infrequent users, such as trainees. Readers are strongly advised to: 1) carefully select the use cases and end users for which subscriptions are assigned and 2) conduct regular and diligent user profile management in order to control costs.

Results. To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year, risk-adjusted total PV of $1.2 million.

Subscriptions And Consumption

Ref.	Metric	Source	Initial	Year 1	Year 2	Year 3
J1	Number of active licensed users	Composite	5	205	205	205
J2	Average annual subscription cost per user for instructions and remote collaboration applications	Interview data	$1,600	$1,600	$1,600	$1,600
J3	Application subscriptions	J1*J2	$8,000	$328,000	$328,000	$328,000
J4	Azure consumption	Interview data	$1,000	$60,000	$90,000	$120,000
J5	Internet accessibility	Interview data	$1,000	$20,000	$20,000	$20,000
Jt	Subscriptions and consumption	J3+J4+J5	$10,000	$408,000	$438,000	$468,000
	Risk adjustment	↑10%				
Jtr	Subscriptions and consumption (risk-adjusted)		$11,000	$448,800	$481,800	$514,800
	Three-year total: $1,456,400			**Three-year present value: $1,203,959**		

PLANNING, IMPLEMENTATION, AND MANAGEMENT

Evidence and data. Implementation costs and labor for mixed reality continue to fall every year as more expertise and apps become available and as use cases become better documented and defined.

However, mixed reality remains at the leading-edge: Successful implementations require significant work to build, test, and evangelize. The time, cost, expertise, and stakeholder buy-in needed to deploy mixed reality and ensure successful adoption must not be underestimated. Mixed reality success requires much more than deploying software; processes must be changed with stakeholders driving change forward.

While remote collaboration can often be deployed quickly and easily with minimal change management, significant effort must be dedicated to work instructions and visualization. Teams must document processes, map out process changes, gather or create 3D assets, build instructions, and test and refine iteratively until the visualizations and instructions provide consistent value to users. Frontline workers and their managers must trust the materials and find the experience to be both relevant and high quality. Otherwise, despite the best efforts of innovation teams, adoption is likely to falter quickly without buy-in from users and stakeholders.

Modeling and assumptions. Forrester modeled the cost for the composite organization assuming:

- The composite organization has a nine-person team that runs key innovation efforts, including the mixed reality deployment. This team includes one extended reality (XR) leader, one developer, three technical project managers, three 3D designers, and one IT administrator. The team is partially dedicated to mixed reality.
- The composite deploys mixed reality apps for instructions, visualization, and remote collaboration over a one-year initial period. Time dedicated to the initial deployment includes: 1) 1,560 hours each for the XR leader and the developer; 2) 2,080 hours for each of the three technical project managers; 3) 1,080 hours for each of the three 3D designers; and 4) 780 hours for the IT administrator.
- The composite organization dedicates significant further development and fine-tuning in Year 1 to extract greater value out of the applications, with benefits fully realized by Year 2 of the analysis. The team continues to maintain and enhance the mixed reality investment moving forward. Time spent by all members of the innovation team decreases in Year 1 and falls further in Year 2 and Year 3.
- Eight test users provide two weeks of labor to testing and providing feedback on the apps prior to deployment, plus one week per user in Year 1 and two days per user in subsequent years.
- The composite incurs $100,000 in Year 1 costs for an SI to provide implementation support, plus an additional $50,000 in Year 2.
- The innovation team holds a retainer expense budget of $50,000 per year to support miscellaneous costs of the investment such as device-shipping costs, travel costs for onsite app testing, or project manager travel for training of first-time HoloLens 2 users.

Risks. Costs will vary significantly per organization depending on a range of factors, including:

- Scale of the deployment and use cases included.
- Ability to find and leverage prebuilt apps for these use cases. Customization and custom development can be much more expensive.
- The number and complexity of mixed reality instructions that need to be created.
- The amount and quality of preexisting 3D digital assets and instructions materials that can be imported and used for mixed reality.

- Potential for excess costs due to organizational constraints such as high levels of customization or rigid security, network access, and device management policies (particularly impactful for highly regulated industries like healthcare).
- Level of in-house expertise and need for an SI.

Results. To account for these risks, Forrester adjusted this cost upward by 15%, yielding a three-year, risk-adjusted total PV of $2.3 million.

Planning, Implementation, And Management

Ref.	Metric	Source	Initial	Year 1	Year 2	Year 3
K1	XR leader hours	Interview data	1,560	1,040	520	520
K2	XR leader fully burdened hourly pay	Payscale.com	$120	$120	$120	$120
K3	XR leader costs	K1*K2	$187,200	$124,800	$62,400	$62,400
K4	3D designer hours	Interview data	3,120	2,080	2,080	2,080
K5	3D designer fully burdened hourly pay	Payscale.com	$40	$40	$40	$40
K6	3D designer costs	K4*K5	$124,800	$83,200	$83,200	$83,200
K7	Developer hours	Interview data	1,560	520	260	260
K8	Developer fully burdened hourly pay	Payscale.com	$63	$63	$63	$63
K9	Developer costs	K7*K8	$98,280	$32,760	$16,380	$16,380
K10	IT admin hours	Interview data	780	520	520	520
K11	IT admin fully burdened hourly pay	Payscale.com	$58	$58	$58	$58
K12	IT admin costs	K10*K11	$45,240	$30,160	$30,160	$30,160
K13	Project management hours	Interview data	6,240	4,160	2,080	2,080
K14	Project management fully burdened hourly pay	D4	$50	$50	$50	$50
K15	Project management costs	K13*K14	$312,000	$208,000	$104,000	$104,000
K16	Test user hours	Interview data	640	320	128	128
K17	Test user fully burdened hourly pay	C9	$30	$30	$30	$30
K18	Test user costs	K16*K17	$19,200	$9,600	$3,840	$3,840
K19	Professional services costs	Partner data	$100,000	$50,000	$0	$0
K20	Expense budget for shipping, travel, and other hardware/software needs	Interview data	$50,000	$50,000	$50,000	$50,000
Kt	Planning, implementation, and management	K3+K6+K9+K12+K15+K18+K19+K20	$936,720	$588,520	$349,980	$349,980
	Risk adjustment	↑15%				
Ktr	Planning, implementation, and management (risk-adjusted)		$1,077,228	$676,798	$402,477	$402,477
	Three-year total: $2,558,980			**Three-year present value: $2,327,511**		

TRAINING

Evidence and data. Before users can benefit from their new mixed reality work experiences, they must first learn to use the HoloLens 2 and the apps running on it; they must also be convinced to use it in their day-to-day work. Investing in user training is critical to drive real adoption of mixed reality, and therefore, for achieving business results. Underinvesting in training can lead to disappointing results; compared to the potential benefit, the costs of a high-quality and well-supported mixed reality training program are easily recouped.

Aside from learning to use the HoloLens 2 itself, training is particularly important for addressing two adjacent needs commonly experienced by interviewees when deploying mixed reality: 1) the need to conduct additional safety training to ensure that users follow rigid safety protocol even after donning the headset and 2) the need to conduct change management training around process redesign that often accompanies development of MR instructions.

Modeling and assumptions. Forrester conservatively modeled user training costs for the composite organization. In most cases, interviewees reported that users required anywhere from 2 hours to 8 hours of training to gain comfort and proficiency with the HoloLens 2 device and MR applications. Given the scale of the composite's deployment, Forrester has modeled 8 hours of training for all 700 to 1,200 users who interact with mixed reality — including those being trained for their work tasks with HoloLens 2.

This conservatism is crucial for capturing two notable externalities that were common for interviewees: 1) the common need to conduct additional safety training to ensure that users follow safety protocol after donning the headset and 2) the risk of additional training that may be needed for change management and process redesign that often occurs when mixed reality instructions are deployed.

Risks. Costs will vary significantly per organization depending on a range of factors, including:

- Number of users and their average salary.
- Complexity and safety of processes and sites where users work.
- Quality and relevance of MR solutions.
- Level of process redesign or change implemented with mixed reality.

Results. To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year, risk-adjusted total PV of $304,000.

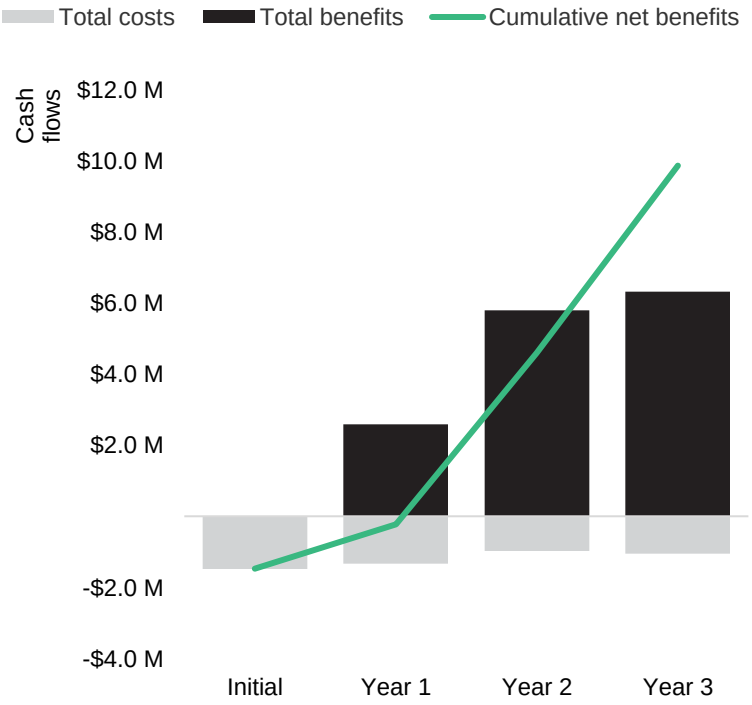
Training

Ref.	Metric	Source	Initial	Year 1	Year 2	Year 3
L1	Number of actual MR users including trainees and device sharing	G9		700	950	1,200
L2	Percentage of users that are new to MR	Interview data		100%	25%	25%
L3	Training and set up hours per new MR user	Interview data		8	8	8
L4	Average fully burdened hourly salary across all MR users	(A4*A6+B9*B11+C9*C11 +D4*D6+E10*E12)/L1		$33	$32	$32
Lt	Training	L1*L2*L3*L4	$0	$184,800	$60,800	$76,800
	Risk adjustment	↑10%				
Ltr	Training (risk-adjusted)		$0	$203,280	$66,880	$84,480
	Three-year total: $354,640			**Three-year present value: $303,544**		

Financial Summary

CONSOLIDATED THREE-YEAR RISK-ADJUSTED METRICS

Cash Flow Chart (Risk-Adjusted)



The financial results calculated in the Benefits and Costs sections can be used to determine the ROI, NPV, and payback period for the composite organization's investment. Forrester assumes a yearly discount rate of 10% for this analysis.

These risk-adjusted ROI, NPV, and payback period values are determined by applying risk-adjustment factors to the unadjusted results in each Benefit and Cost section.

Cash Flow Analysis (Three-Year, Risk-Adjusted Estimates)

	Initial	Year 1	Year 2	Year 3	Total	Present Value
Total costs	($1,474,103)	($1,336,816)	($978,389)	($1,048,283)	($4,837,590)	($4,285,566)
Total benefits	$0	$2,587,919	$5,792,153	$6,320,323	$14,700,395	$11,888,110
Net benefits	($1,474,103)	$1,251,103	$4,813,764	$5,272,041	$9,862,804	$7,602,544
ROI						177%
Payback period						13 months

Appendix A: Total Economic Impact

Total Economic Impact is a methodology developed by Forrester Research that enhances a company's technology decision-making processes and assists vendors in communicating the value proposition of their products and services to clients. The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

TOTAL ECONOMIC IMPACT APPROACH

Benefits represent the value delivered to the business by the product. The TEI methodology places equal weight on the measure of benefits and the measure of costs, allowing for a full examination of the effect of the technology on the entire organization.

Costs consider all expenses necessary to deliver the proposed value, or benefits, of the product. The cost category within TEI captures incremental costs over the existing environment for ongoing costs associated with the solution.

Flexibility represents the strategic value that can be obtained for some future additional investment building on top of the initial investment already made. Having the ability to capture that benefit has a PV that can be estimated.

Risks measure the uncertainty of benefit and cost estimates given: 1) the likelihood that estimates will meet original projections and 2) the likelihood that estimates will be tracked over time. TEI risk factors are based on "triangular distribution."

The initial investment column contains costs incurred at "time 0" or at the beginning of Year 1 that are not discounted. All other cash flows are discounted using the discount rate at the end of the year. PV calculations are calculated for each total cost and benefit estimate. NPV calculations in the summary tables are the sum of the initial investment and the discounted cash flows in each year. Sums and present value calculations of the Total Benefits, Total Costs, and Cash Flow tables may not exactly add up, as some rounding may occur.

PRESENT VALUE (PV)

The present or current value of (discounted) cost and benefit estimates given at an interest rate (the discount rate). The PV of costs and benefits feed into the total NPV of cash flows.

NET PRESENT VALUE (NPV)

The present or current value of (discounted) future net cash flows given an interest rate (the discount rate). A positive project NPV normally indicates that the investment should be made, unless other projects have higher NPVs.

RETURN ON INVESTMENT (ROI)

A project's expected return in percentage terms. ROI is calculated by dividing net benefits (benefits less costs) by costs.

DISCOUNT RATE

The interest rate used in cash flow analysis to take into account the time value of money. Organizations typically use discount rates between 8% and 16%.

PAYBACK PERIOD

The breakeven point for an investment. This is the point in time at which net benefits (benefits minus costs) equal initial investment or cost.

Appendix B: Interview Data Demographics

Forrester conducted customer interviews with 23 decision-makers from 21 organizations that have deployed a range of mixed reality applications via Microsoft HoloLens 2 devices.

Interviewed Decision-Makers From Organizations Using Mixed Reality On Microsoft HoloLens 2

Interviewee	Industry	Region	Annual Revenue
X-reality principal investigator	Aerospace manufacturing	North America	More than $25 billion
IT X-reality leader	Automotive manufacturing	Global, based in Europe	More than $25 billion
• Innovation portfolio manager • Senior research engineer	Automotive manufacturing	Global, based in North America	More than $25 billion
• Chief information officer • VP of innovation	Automotive manufacturing	Global, based in Europe	$10 billion to $25 billion
Director of research, development, and engineering (RD&E)	Chemicals manufacturing	Global, based in North America	$10 billion to $25 billion
Mechanical engineering lead	Consumer products manufacturing	Global, based in Europe	More than $25 billion
Digital transformation leader	Electrical manufacturing	Europe	Less than $1 billion
Product line general manager	Industrial manufacturing	Global, based in North America	More than $25 billion
Training and technical services director	Life sciences manufacturing	Global, based in North America	More than $25 billion
Innovation product director	Power manufacturing	Global, based in Europe	$10 billion to $25 billion
X-reality innovation leader	Robotics manufacturing	Global, based in North America	More than $25 billion
VP of design and engineering	Construction and engineering	North America	Less than $1 billion
Corporate controls manager	Construction and engineering	North America	Less than $1 billion
Global health program manager	Healthcare provider	Global, based in North America	$1 billion to $10 billion
Doctor and chief clinical information officer	Healthcare and education provider	Europe	Less than $1 billion
Surgeon and medical education director	Healthcare and education provider	Asia	Less than $1 billion
Clinical scientist and professor	Healthcare and education provider	Europe	$1 billion to $10 billion
Associate dean of professional and graduate programs, head of center of excellence	Education	North America	$1 billion to $10 billion
Executive director of innovation	Education	North America	$1 billion to $10 billion
Technology innovation leader	Energy	Global	More than $25 billion
Product manager	IT services	Europe	Less than $1 billion

Appendix C: Supplemental Material

“A Good Customer Experience Requires Workers To Be Digitally Enabled,” Forrester Research, Inc., February 18, 2020.

April 2, 2020, “Augmented Reality And The Internet Of Things: A Match Made In Heaven?” Webinar, (https://www.forrester.com/webinar/Augmented+Reality+And+The+Internet+Of+Things+A+Match+Made+In+Heaven/-/E-WEB30568).

“Augmented Reality And Virtual Reality In Industry: Good For More Than Just Training,” Forrester Research, Inc., March 11, 2019.

“Build A Business Case For Enterprise Smart Glasses,” Forrester Research, Inc., September 30, 2016.

“Combine Augmented And Mixed Reality With IoT To Deliver Insight At The Point Of Need,” Forrester Research, Inc., January 8, 2020.

“Digital Tools Bring Workers Closer To Their Physical Environment,” Forrester Research, Inc., September 28, 2021.

“Don’t Miss Your Anywhere-Work Opportunity,” Forrester Research, Inc., March 29, 2021.

“Emerging Technology Spotlight: Augmented, Virtual, And Mixed Reality,” Forrester Research, Inc., October 22, 2018.

“Extended Reality Will Help Manufacturers With More Than Just Training And Remote Assistance,” Forrester Research, Inc., February 12, 2019.

“Forrester’s 2021 Technology Trends,” Forrester Research, Inc., September 29, 2021.

“How To Adapt When Your Workforce Ecosystems Are Breaking,” Forrester Research, Inc., June 19, 2020.

“How To Successfully Scale Your Augmented Reality Device Rollout,” Forrester Research, Inc., August 3, 2021.

“Insights-Driven Employee Experiences Are Shaping Our New Hybrid Workforces,” Forrester Research, Inc., September 21, 2021.

“New Tech: Augmented Reality, Virtual Reality, And Mixed Reality, Q1 2019,” Forrester Research, Inc., January 23, 2019.

“The CEO’s Guide To The Future Of Work,” Forrester Research, Inc., June 8, 2020.

“The CIO’s Guide To Augmented, Mixed, And Virtual Reality,” Forrester Research, Inc., November 21, 2019.

“The Experience Of 2020 Will Initiate Long-Awaited Growth In Enterprise Augmented, Mixed, And Virtual Reality,” Forrester Research, Inc., September 3, 2020.

“The Extended Reality Opportunity Today: Your Employees,” Forrester Research, Inc., February 21, 2020.

“The Future Of Employee Computing,” Forrester Research, Inc., January 18, 2019.

“The Future Of Work Starts Now,” Forrester Research, Inc., August 2, 2021.

“The Long-Term Impact Of Emerging Technology On US Healthcare Providers,” Forrester Research, Inc., July 1, 2020.

“The Microsoft Mixed Reality Business Opportunity For Independent Software Vendors,” a commissioned study conducted by Forrester Consulting on behalf of Microsoft, July 2019.

“The Microsoft Mixed Reality Business Opportunity For System Integrators,” a commissioned study conducted by Forrester Consulting on behalf of Microsoft, July 2019.

“The Path To Customer Obsession Is Paved With Enterprise Collaboration,” Forrester Research, Inc., October 20, 2020.

“The Recipe For Technology Innovation Success Is Changing,” Forrester Research, Inc., September 20, 2021.

“The State Of Employee Computing, 2021,” Forrester Research, Inc., August 2, 2021.

“The Technology-Augmented Employee,” Forrester Research, Inc., February 13, 2018.

“The Total Economic Impact Of Microsoft Dynamics 365 Remote Assist,” a commissioned study conducted by Forrester Consulting on behalf of Microsoft, June 2020.

“Top Trends And Emerging Technologies, Q3 2020,” Forrester Research, Inc., September 22, 2020.

“Understand The Differences Between EX And CX,” Forrester Research, Inc., August 2, 2021.

“Your Virtual Office In The Cloud,” Forrester Research, Inc., August 13, 2021.

Appendix D: Endnotes

[1] Total Economic Impact is a methodology developed by Forrester Research that enhances a company’s technology decision-making processes and assists vendors in communicating the value proposition of their products and services to clients. The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

[2] Source: “The Future Of Work Starts Now,” Forrester Research, Inc., August 2, 2021.

[3] Source: “The Experience Of 2020 Will Initiate Long-Awaited Growth In Enterprise Augmented, Mixed, And Virtual Reality,” Forrester Research, Inc., September 3, 2020.

[4] Source: “The CIO’s Guide To Augmented, Mixed, And Virtual Reality,” Forrester Research, Inc., November 21, 2019.

[5] Source: “Economic and Health Benefits of a PPE Stockpile,” UC Berkeley School of Public Health and UC Berkeley Labor Center, August 12, 2020 (https://laborcenter.berkeley.edu/economic-and-health-benefits-of-a-ppe-stockpile/).

[6] Source: “Introducing Forrester's Employee Experience Index,” Forrester Research, Inc., February 14, 2019.

[7] Net Promoter and NPS are registered service marks, and Net Promoter Score is a service mark, of Bain & Company, Inc., Satmetrix Systems, Inc., and Fred Reichheld.

[8] Source: “Insights-Driven Employee Experiences Are Shaping Our New Hybrid Workforces,” Forrester Research, Inc., September 21, 2021.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