VIVE

The State of Extended Reality (XR) in Manufacturing

Key Findings From 2024 Survey of
400 U.S. Manufacturing Professionals

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Introduction

With its unprecedented ability to enhance today's standard business practices, several industries are embracing extended reality (XR) as their next-gen tool. Automotive, industrial, and energy manufacturers are all beginning to adopt XR to improve training, prototyping, data visualization, and collaboration. The goal? Mitigate risks, accelerate the flow and control of information, and produce and introduce higher-quality products to the market faster, ultimately reducing costs and achieving desired revenue results.

To learn more about the state of XR in manufacturing, HTC VIVE conducted a wide-ranging survey of U.S. manufacturing professionals across 10 different industries. From motor vehicles and electronics to chemical and energy products, we made a few key discoveries:

- Half of the respondents already use XR (177 versus 179 who do not).

- XR has achieved clear returns on investment (ROI) for 75% of respondents, with benefits that include reduced material waste, time savings, and cost savings.

- Of the 179 respondents who do not use XR, 59% intend to start using it within the next five years. Furthermore, an additional 19% have plans to adopt XR within the following ten years. In total, a majority of 74% have intentions to integrate XR within the next decade.

However, barriers still exist for its mass adoption. Some manufacturing professionals hesitate to make the necessary upfront investments, both in the hardware and software, and in training their employees to use the XR solutions. The longer they delay, the farther behind they'll fall to competitors who have already begun enhancing their workflows with XR.

In addition to our data demonstrating a clear return on investment by use case, it identifies several untapped manufacturing opportunities ready for improvement. Large and diverse implementations of XR are no longer a question of if — it's now a question of when.

Before proceeding, let's discuss how the data was collected.

What is XR?

Extended reality (XR) includes augmented, virtual, and mixed reality.

Augmented reality (AR): a view of the real world with an overlay of digital elements.

Virtual reality (VR): a fully immersive digital environment.

Mixed Reality (MR): a view of the real world with an overlay of digital elements where physical and digital elements can interact.

Methodology

HTC VIVE conducted a survey of 400 manufacturing professionals throughout the US in September 2023 and published the results in February 2024. The survey targeted leaders in training and development, purchasers, and key decision-makers across the industry, aiming to understand the current levels of XR adoption, assess the success professionals have experienced in applying XR, and explore the potential direction of XR in manufacturing.

Industries surveyed included:

- Computer and Electronic Products

- Chemical Products

- Petroleum and Coal Products

- Food, Beverage, and Tobacco Products

- Motor Vehicles, Trailer, and Auto Parts

- Machinery

- Fabricated Metal Products

- Primary Metals

- Plastics and Rubber Products

- Wood Products

The survey began with one screening question to ensure the audience selected was relevant. After this, 19 single-select and multi-select questions gauged participant experiences and upcoming expectations of XR in manufacturing. The polling processes and data analysis used to present this report reveal its statistical results with 95% confidence and a 5% margin of error.

The Current Role of XR
in Manufacturing

As the popularity of XR continues to grow, an increasing number of industries recognize its potential to enhance their operations. For manufacturing, industrial, and energy firms, XR technology has proven invaluable at the training stage. Acquiring a manufacturing skillset is typically time-consuming, costly, and potentially hazardous. While learning to operate a forklift can be relatively safe, it still entails risks such as equipment malfunction, potential collisions, and ongoing expenses related to refueling and maintenance.

Shifting training to XR enables manufacturers to proactively tackle these concerns. In the case of forklift operation, trainees can master essential skills through a hyper-realistic XR simulation, mitigating the exposure to associated risks. Training virtually before setting foot on an actual forklift ensures operators are knowledgeable and prepared, allowing the process to become infinitely repeatable and elevating the standards for quality and speed of work. XR also introduces additional benefits, including enhanced performance data, session playback, and more. Once trainees establish a baseline competence in XR, they can expedite their real-world training, requiring less time and fewer resources.
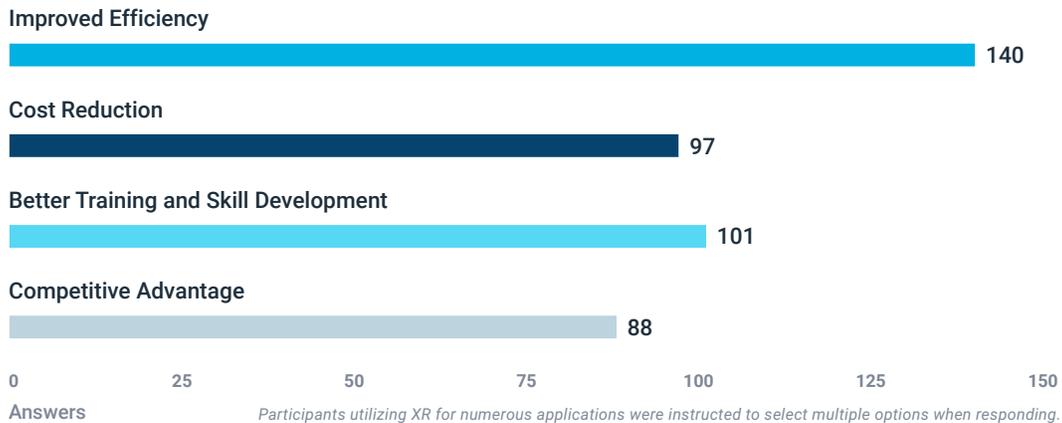
More than nine in 10 respondents who currently use XR felt safer on the job after going through an XR-simulated environment.
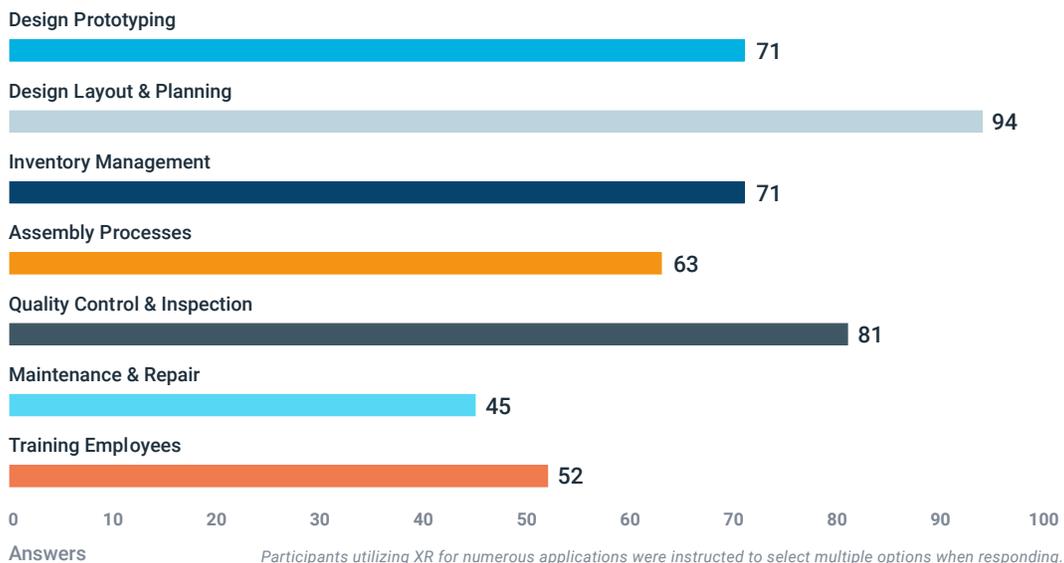
Image courtesy of Flint Systems

The widespread adoption of XR training makes sense, with more than half of respondents (51%) who use it citing enhanced training or skill development as their primary motivation for incorporating XR. Manufacturers have also embraced XR in the pursuit of cost reduction (45%) and an even higher percentage (67%) are driven by the prospect of improved efficiency.

What motivated your organization to adopt XR technology in manufacturing?

Improved Efficiency
140

Cost Reduction
97

Better Training and Skill Development
101

Competitive Advantage
88

0   25   50   75   100   125   150

Answers   *Participants utilizing XR for numerous applications were instructed to select multiple options when responding.*

The varied motivations highlight the versatility of XR. Respondents have harnessed XR to tackle a broad spectrum of challenges that span the entire manufacturing process. Whether in the initial stages involving design and prototyping, or at the culmination for addressing tasks like quality control and inspection, manufacturers are leveraging XR to improve their processes. Here's an overview of how respondents are currently employing this technology:

In which areas of manufacturing does your organization currently utilize XR technology?

Design Prototyping
71

Design Layout & Planning
94

Inventory Management
71

Assembly Processes
63

Quality Control & Inspection
81

Maintenance & Repair
45

Training Employees
52

0   10   20   30   40   50   60   70   80   90   100

Answers   *Participants utilizing XR for numerous applications were instructed to select multiple options when responding.*

One of the more notable strengths of extended reality lies in its ability to faithfully replicate objects of any size, down to the most minute detail. This capability is particularly advantageous in the realms of planning and design. Manufacturers employing XR in these stages can avoid the commitment of valuable resources and materials by assembling and evaluating prototypes, computer-aided designs (CAD), and building information modeling (BIM) layouts in the virtual space first, affording a thorough, meticulous inspection of plans at any scale—a critical aspect as geographic information system (GIS) data and assemblies become progressively intricate.

Designers can also collaborate and modify XR designs quickly and cost-effectively in a simulated environment, outpacing their physical counterparts. Creating virtual designs and overlaying detailed mapping data can lead to higher-quality work within a shorter timeframe and improves productivity and safety on the factory floor.

Moving down the production line, quality assurance testers can use XR to compare products on the floor against their original designs. Applying readily accessible reference materials can accelerate quality control, making it much easier to identify and improve product quality.

Compliance inspectors can employ XR in a similar manner, using XR devices with infrared thermographics to readily catch potential points of failure or areas known to overheat in machinery, ensuring everything stays in proper working order.

Market research anticipates XR revenue to surge from $22.7 billion in 2022 to $70.1 billion in 2027 by 2028[1]
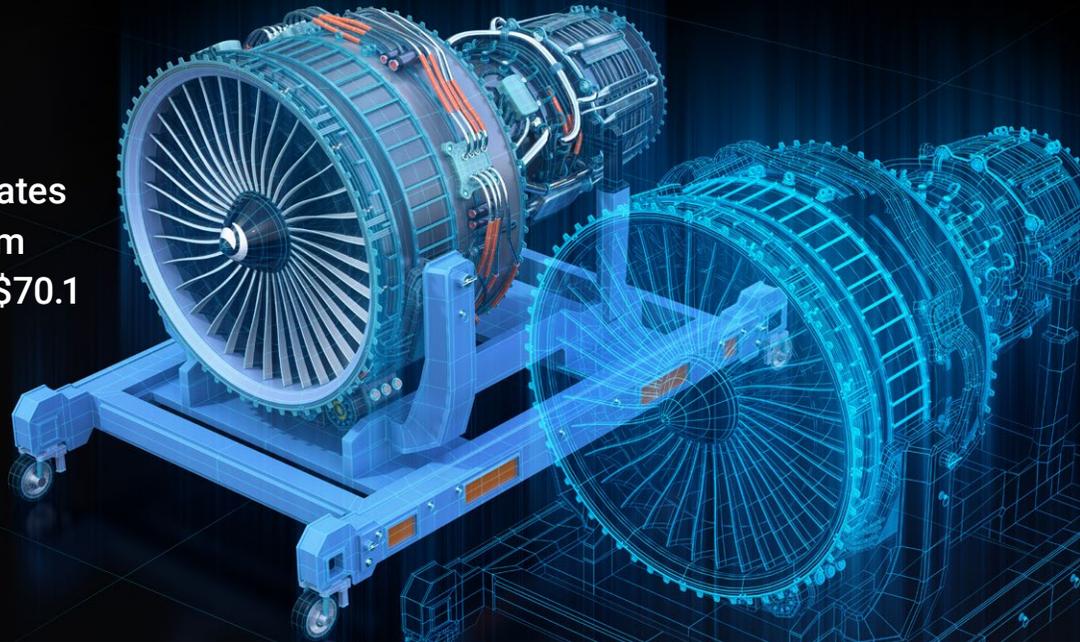
The Future of XR in Manufacturing

Despite its maturing adoption rates, XR is preparing to expand further. Market research anticipates the XR market to surge with manufacturing playing a pivotal role in this growth.

Of the 400 survey respondents, 179 currently do not use XR (177 do, and 44 don't know). Among non-users, 59% expressed their intention to start using XR within five years, with nearly three-quarters (74%) planning to adopt it within the next decade. This data emphasizes that manufacturers acknowledge the value of XR and are actively looking for suitable opportunities to embrace this transformative technology.

The opportunity appears imminent. Given the success of current XR applications, it is likely that manufacturers will persist in utilizing the technology for training, quality control, and design prototyping. However, exploration into additional applications is already underway. Survey respondents who use XR see use-case design layout and planning as the areas with the highest potential, followed closely by quality control and inspection. Manufacturers who have already embraced XR will enjoy a headstart in discovering these new value additions. This advantageous position enables them to continue compounding the benefits already gained by investing in XR earlier than their competitors, potentially leaving the latter playing catch-up.

40% of respondents foresee the future landscape of manufacturing heavily relying on XR for tasks such as inventory management, quality control, and inspection, alongside maintenance and repair.

[1]ARtillery Intelligence, https://artilleryiq.com/reports/xr-global-revenue-forecast-2022-2027/

Perceived Barriers to XR in Manufacturing

Divergent perspectives exist within the sector regarding the envisioned growth of XR. Some have refrained from integrating this technology into their work, pointing to several stumbling blocks that have hindered their adoption of XR:

- Knowledge gaps and insufficient training around XR

- Prohibitive hardware and software costs

- Challenging XR integration processes

- Insufficient privacy and security

Knowledge Gaps

According to 89% of respondents who use XR, manufacturing workers are uncomfortable using the technology without being trained first. That's a reasonable feeling, but it's led to a hesitation by half (50%) of respondents to invest in XR. And, where respondents have tried to skip out on training, 31% have found their workers misusing equipment in ways that led to downtime. The lesson is clear: Every tool has a learning curve, and workers need adequate training before using XR effectively.

89% of respondents who use XR say their workers were uncomfortable using XR without training

50% of respondents who do not use XR believe there is too high of a learning curve

31% of XR-using respondents reported untrained workers misusing equipment and causing downtime

Upfront Costs

Many respondents who don't use XR cited hardware and software costs (46%) as a barrier preventing their adoption of the technology. While hardware expenses can be considerable, particularly when equipping a large staff with headcounts in the hundreds, there are more budget-friendly alternatives, such as the VIVE Flow for Business and VIVE XR Glasses Business Edition. These alternatives can lower the bar to entry, including implementing proof of concepts, limited test adoptions, and gradual rollouts.

Integration Challenges

Incorporating XR into existing technology stacks and workflows may seem challenging, as nearly half of respondents who don't use XR identified integration concerns as a deterrent (46%). Leaders must evaluate where XR brings the most benefit within their current spatial computing and Industrial Internet of Things (IIoT) workflows and develop a strategic rollout and management plan. Workers will also need an adjustment period to acclimate to their new tools and processes, creating the possibility of short-term slowdowns that could discourage some manufacturers from embracing the technology.

Privacy and Security

Lastly, privacy and security concerns were cited at a slightly lower rate (25%) by respondents who don't use XR. At the same time, respondents who already use XR indicated it as a key differentiation among XR solutions. More XR-using respondents described security and privacy as the key difference-maker among solutions than any other factor (19%).

These numbers indicate the importance of security among manufacturers, who store a significant amount of information digitally. That info ranges from financial data to client information. Ensuring the complete confidentiality of this information is crucial, as any breach could lead to ransomware attacks, theft of proprietary designs, compliance violations, and reputational damage. Emerging network-connected technologies like XR may introduce additional access points that require robust security measures.

Why Now Is the Time to Invest in XR Manufacturing

While these perceived barriers may seem significant, our data indicates they're not as severe as manufacturers fear. The findings demonstrate that integrating XR into manufacturing is more manageable than some respondents anticipate and that the returns for implementing are already substantial.

Training

XR is no longer a foreign technology for the average person, and the training outcomes from respondents mirror that level of familiarity. Of the manufacturers using XR, the majority (54%) confirmed their teams adapted quickly and required only minimal training. That meant they saw little lag between bringing in new technology and enjoying its benefits.

Cost

While the initial expenses linked to XR might discourage some potential investors, the survey shows that 75% of respondents who use XR have witnessed a return on their XR investments. Over time, as this return accumulates, manufacturers not only offset the upfront costs but also find themselves ahead. In essence, investing in XR technology is an investment in infrastructure that yields dividends.

Integration

Likewise, the management of devices and its integration challenges may not be as significant as holdouts expect. 63% of respondents who already use XR described the process of incorporating it into their workflow as either "seamless" or requiring minimal support. In fact, more respondents reported experiencing seamless integration efforts than encountering a struggle. The smoother the integration, the faster XR users can start recovering their investment.

Security

Finally, it's worth noting that numerous XR designers have attained a level of security that garners admiration, even from the U.S. military, which employs VR across all six branches. Utilizing XR technology that has passed military vetting can ensure business information remains secure and confidential.

Benefits for XR Adopters

Our data demonstrates that overcoming these perceived barriers can yield substantial benefits across a wide array of processes. XR has evolved considerably since its introduction to manufacturing. As the technology matures, early adopters stand to gain even greater benefits. The sooner a business invests, the quicker it can access these advantages.

49% of XR-using respondents saw less material and resource waste.
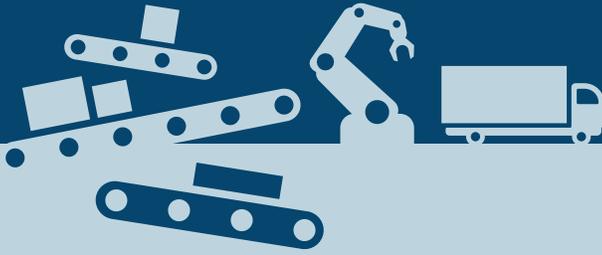
48% of XR-using respondents saved time on manufacturing processes.

45% of XR-using respondents enjoyed cost savings.

95% of XR-using respondents felt safer on the job after going through an XR-simulated environment.

Conclusion

The manufacturing industry stands on the precipice of a new era propelled by XR. Our research indicates that XR has established itself to be effective and easy to integrate for manufacturing firms, yet it has not been universally achieved. The proven benefits of waste reduction, accelerated manufacturing times, improved worker safety, and cost savings are just the beginning. XR's potential to enhance inventory management and boost maintenance processes could lead to even less waste, less downtime, and further increases in productivity. Consequently, manufacturers who embrace this technology now have the opportunity to gain a significant competitive edge over others in the field.

XR developers aiming to attract manufacturers face two primary design challenges. A significant portion of the manufacturing industry lacks the necessary expertise to leverage XR fully. To bridge this skill gap, designers must heavily invest in creating user-friendly XR solutions, minimizing the delay between acquiring the technology and deploying it effectively. Similarly, XR designers must ensure their solutions integrate with pre-existing manufacturing processes and technology stacks. By eliminating these barriers to entry, manufacturers will be more inclined to incorporate XR into their workflows.

If you're ready to secure a competitive advantage and streamline processes using XR, HTC VIVE is here to help. Our advanced XR solutions have proven successful in expediting design workflows for manufacturers. Contact us today to explore how our full-stack ecosystem, including our top-tier hardware and software solutions with industry-leading ISV and implementation support can enhance and accelerate your manufacturing processes.

About HTC VIVE

HTC VIVE is the premier extended reality (XR) platform and ecosystem that creates true-to-life XR experiences for businesses and consumers. The VIVE ecosystem delivers premium XR hardware, software, and content. VIVE Business encompasses best-in-class XR hardware, Business Device Management System (DMS), and software and solutions, including VIVERSE for Business, VIVE Business+, VIVE Location-Based Software Suite (LBSS), and VIVE Business Streaming (VBS) for SMB and enterprise customers. For more information, please visit business.vive.com.