

WHITEPAPER

The Role and Future of Immersive Training in Enterprises



The Role and Future of Immersive Training in Enterprises

A comprehensive analysis of VR/AR technology and its usefulness (at present and in the future) for enterprises in different industries.

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FOREWORD

The adoption of software by enterprises for internal business processes has accelerated over the past two decades, leading to major changes in the way most companies operate. As enterprises have gained unprecedented opportunities to transform their operations with software, many of them experience uncertainty about which aspects/processes should be integrated.

One practice that generates particular and substantial consternation is the use of software for professional training, especially if it is based on immersive technology. Virtual reality and augmented reality technology (both classified as forms of XR - extended reality) are sometimes perceived as new and untested, so there is a major question about their purpose and value in the field of training development.

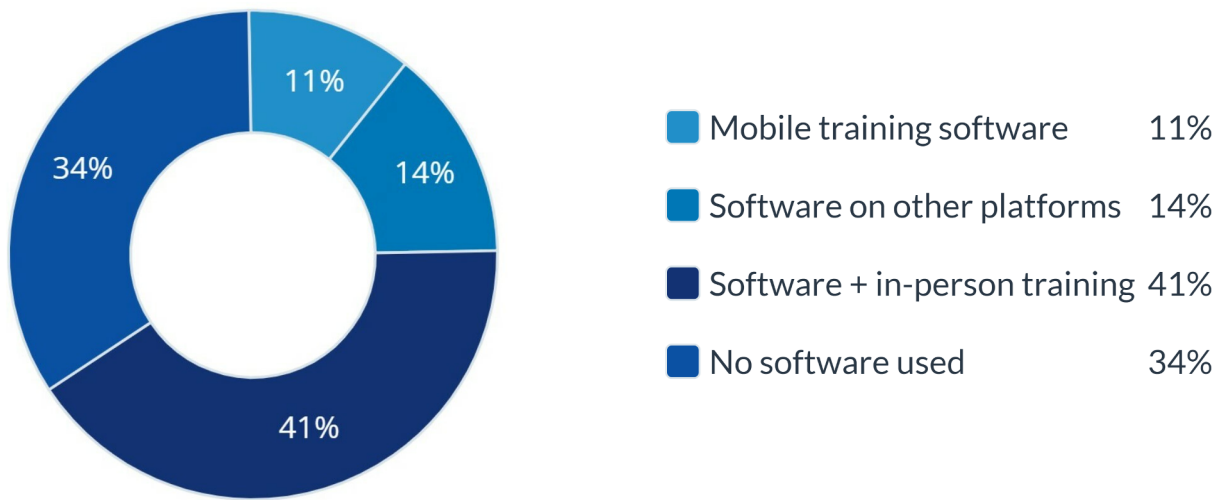
In this paper, we will examine the current state of the immersive tech market, how this technology is being used for training systems, and what the future holds for it based on current trends and data. Its purpose is to serve as a reference for any company interested in this application of immersive technology.

1. WHY DO COMPANIES IMPLEMENT TRAINING SYSTEMS?

There is ample evidence to suggest that a majority of companies with an online presence use software to fulfill all or part of their worker training needs.

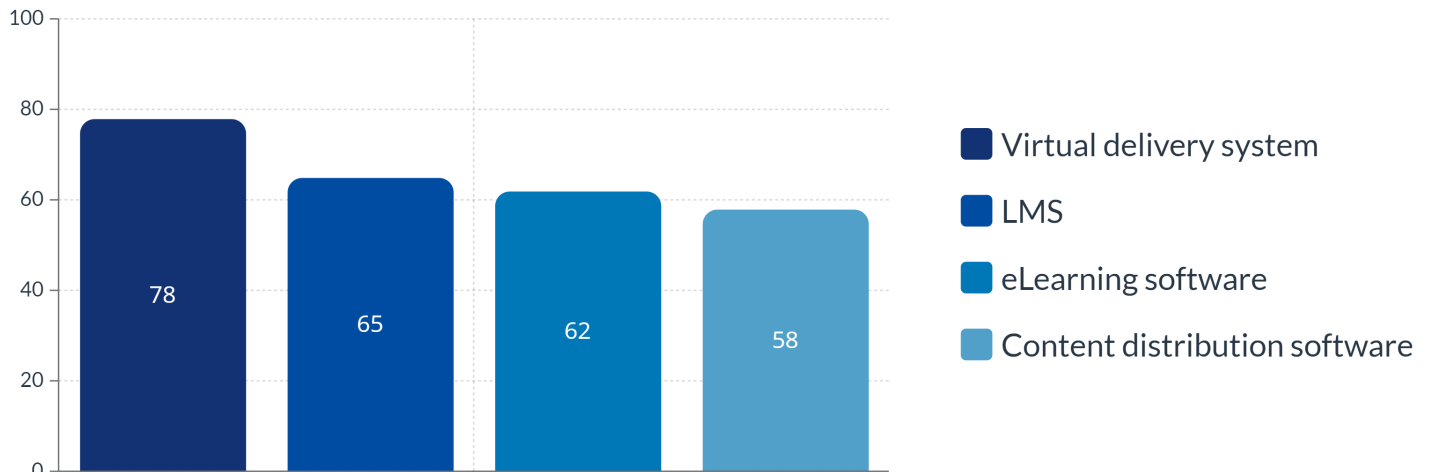
For example, a survey [1] conducted by Raccoon Gang that involved 2000 business representatives among 15 industries found that 11% of respondents used mobile training software and 14% used another type of virtual software. The same report noted that 41% used software in combination with in-person training.

Training software used by enterprises



Another survey [2] conducted by Mimeo placed the percentage of companies surveyed using digital learning software at 62%.

Types of learning software used by companies



While these statistics point to training software being popular, they do not explain the reason for it. Thus, to provide some insight into the prevalence of training software, let's examine what business leaders have said about training software used by their company or in general:

- "It's designed to meet the needs of a younger workforce" - Heather Stratford, Drip 7 Inc.
- "If you can create a high-fidelity training environment where you can practice the skills, you increase access and training in areas where you may not have had the opportunity before" - Dan Ortega, Global Wind Association.
- "We saw an opportunity to engage our associates better" - Joey Sippel, Honda.
- "It (training software) is not foolproof but it helps us find some very good people" - Ben Bouldin, Royal Caribbean Cruises.
- "We're trying to accelerate change and we don't want to be stuck in the times of using paper books when there's a better way to do it" - Chase Evans, U.S. Air Traffic Control.
- "Different learners have a different learning pace" - Cheang Wei Ting, Singapore Prison Training Institute.
- "We wanted a better system. We wanted to bring new employees together and provide them with on-the-job opportunities that will grow their understanding" - Doug Greene, ACC-Redstone.
- "If you look at the world of work and the way the labor market has changed specifically because of the pandemic, there's a real need for digital skills no matter what job you have" - Sheila Ireland, Pennsylvania Department of Labor.

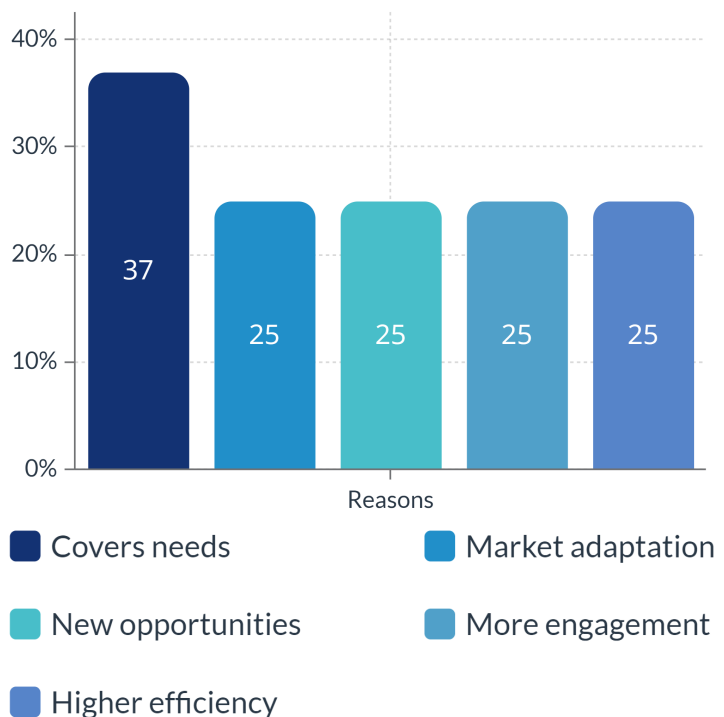
While these statements are hardly cover all the factors and circumstances that lead to companies implementing educational software, they can serve as a snapshot into the thought process of business leaders who make such decisions and a small control group.

In this context, we can categorize the reasons:

1.1 Companies chose training software because*:

- It accommodates the needs of individual workers or groups (3/8) = 37%
- It is a necessary adaptation to market changes (2/8) = 25%
- It provides workers with previously unavailable opportunities (2/8) = 25%
- It improves worker engagement (2/8) = 25%
- It boosts the efficiency of company operations (2/8) = 25%

Why companies choose training software



*** The represented data was received by voting eight companies using a multiple non-transferable vote system, in which one respondent selects several options at once.**

Generalizing further, we can see that simply seeing the opportunity to modernize and taking it is not the prevailing motivator. Instead, companies see this type of solution as vital to maintain their position in the market, boost operations and worker productivity, and accommodate the needs of large worker demographics.

1.2 A look back at the history of training software:

For millennia, people mostly received their professional training directly on the job, or (in the past several centuries), in universities. Written text has also accompanied training processes for thousands of years, with the earliest training manual (for the care of horses) found on a stone tablet dating back 3,000 years [3].

As books became accessible in the 1820s [4], enterprises made use of the technology to print instructional materials, and manuals/guidebooks became dominant for hundreds of years. However, our focus is on computer software, which only became available to the public in the latter half of the 20th century.

1960 was a big year for training software, because PLATO (the first computer-assisted instruction system) came online [5]. At first, this system was limited to the University of Illinois, but was eventually distributed to thousands of terminals worldwide, including companies.

1.4 Mainstream adoption

As personal computers became popular, so did enterprise training software built for them by enterprises. For example, in 1982, the CTS (Computer Training Systems) company began developing training software for pilots that ran on Apple II computers [8].

Plymouth Perinatal Research Group (a medical organization now known as K2 Medical Systems) was another trailblazer in this field, setting up a system to train for patient monitoring in 1989 [9]. With time, many other companies followed suit, and by the 1990s, many businesses were using electronic performance support systems (EPSS) [10].

1.3 The first enterprise training software

Control Data Corporation (a supercomputer firm) was a pioneer in this field, deploying the PLATO learning system in their own offices in 1974, providing manuals and training materials through it [5]. However, it is important to mention that in the 1960s-70s computers were still a niche and expensive product that few companies could afford.

A true breakthrough in PC and software adoption came in 1977 with the release of the Apple II computer, 1981 with the release of the IBM PC [6], and the Commodore 64 in 1982 [7]. These 3 computer models are arguably the most influential in forming the market for PC hardware and software which is thriving to this day.

1.5 The advent of immersive training

While the first mainstream immersive devices (VR headsets) appeared on the market in 1987 [11], it wasn't until a decade later that industries began examining the technology as the next step in the evolution of training software. For example, in 1998, the Mine Safety and Health Administration in the U.S. studied and commented on providing such solutions to miners.

They wrote that VR "provides the best training by immersing students in situations that are as close as possible to the real world" [12].

While it is difficult to trace the first real XR training programs with currently available resources, the earliest example we identified in our study was the BioSimMer program developed by the U.S. government in 1998 [13]. This program trained first responders with VR helmets to react to dangerous bioweapon events.

From that point and into the 2000s, the incidence of immersive training studies and reports increases exponentially. Though AR as a concept existed as early as 1968, the earliest mobile AR apps only started appearing in the 2010s.

VR

"provides the best training by immersing students in situations that are as close as possible to the real world"

Mine Safety and Health
Administration

2. WHY ENTERPRISES SELECT IMMERSIVE TRAINING OVER ALTERNATIVE PLATFORMS

Previous studies on the use of immersive training have mostly focused on the results of implementing this technology or overall worker sentiments and attitudes toward it.

For example, a survey [14] of 400 adults in the UK conducted by Dell and Intel found that two-thirds of surveyed millennials and remote workers are open to using AR/VR in their work processes. However, this study and others like it do not properly examine the reasons why enterprises choose VR or AR as the platform of choice for their training software.



With the median cost of developing a mid-range app reaching \$36K-\$85K [15] in 2021 and an average development time of 2-4 months [15], it is understandable that business owners would not make the choice of platform lightly, and numerous factors would inform their decision.

To get some insights into the reasoning behind this decision, let's examine the statements made by business leaders that chose immersive training and extract the key influencing factors.

- “We believe the near boundless possibilities and capabilities of simulation training will make [...] our industry safer, one student at a time” - Albert Faciane, New Orleans Fire Department.
- “Now, there’s been an enhancement to the effectiveness of distance learning. They’re seeing that they can turn this situation into an engaging remote learning setting with both AR and VR” - Ray Briggs, Deloitte.
- “The biggest benefit by far is that it is effective learning that condenses and accelerates the learning time.” - Doug Donovan, Interplay.
- “The technology can play a role in filling the skills gap across many different areas, especially training in extreme or specific environments” - Charlotte Coles, IDTechEx.
- “(Virtual reality) doesn’t replace traditional teaching, but it augments it” - Richard Rowe, Navicent Health.
- “The equipment is portable and can be set up almost anywhere” - Paul Payne, Bridgewater Township Police.
- “AR actually makes learning more fun and engaging” - Afiqah Suhaini, Singapore ICA “VR levels the playing field in a way that doesn’t happen with in-person methods and provides the flexibility for more frequent participation in simulation.” - Kathryn Schaivone, Kaiser Permanente.

Once again, these viewpoints are not exhaustive or entirely representative of business leaders as a whole, but we can still use them to draw some limited conclusions about the switch to immersive training software.

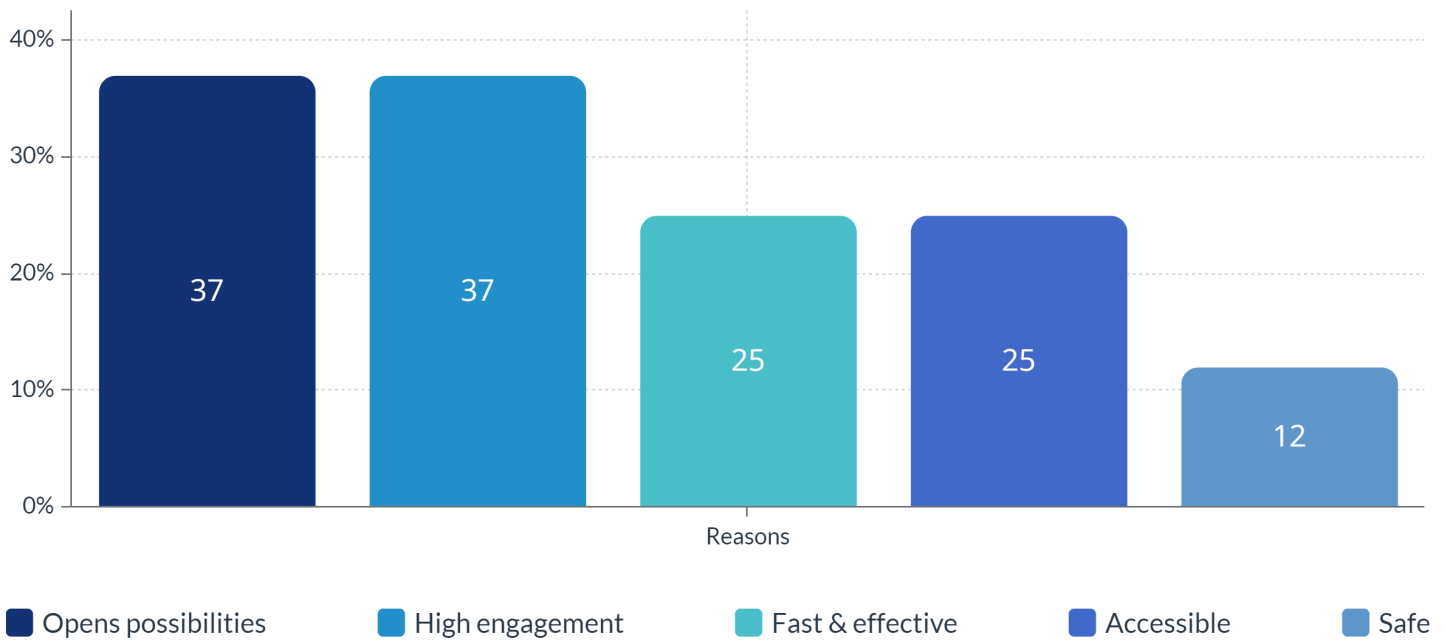
Based on the viewpoints, we can categorize the reasons below.

Companies chose immersive training software because**:

- It opens up new possibilities in employee education (3/8) = 37%
- It boosts trainee engagement (3/8) = 37%
- It is faster and more effective (2/8) = 25%
- It is more accessible to workers (2/8) = 25%
- It is safer than alternatives (1/8) = 12%

As you might notice, some of these reasons are similar to the aforementioned (why training software in general is implemented) - specifically in the aspects of boosting worker engagement and opening up new possibilities. However, immersive solutions also seem to carry some unique benefits, such as faster education, increased safety, and high accessibility.

Why immersive training software is in demand



** The represented data was received by voting eight companies using a multiple non-transferable vote system, in which one respondent selects several options at once.

3. ADDRESSING COMMON MISCONCEPTIONS ABOUT IMMERSIVE TRAINING SOLUTIONS

Having examined key reasons why business leaders select immersive tech for their training needs, we should also address the flip side – arguments and beliefs that motivate against such decisions. In communications with potential clients, VR development companies hear numerous concerns about the technology and its suitability for projects. Unfortunately, many of these concerns are rooted in misconceptions and unfounded distrust.

To get to the truth of the matter, let’s examine these misconceptions from multiple angles in the table below.

Misconception	Supporting Points	Rebuttal
1. AR/VR hardware is too expensive to use for training	The prohibitive cost of VR hardware is often mentioned as an impediment to selection. Companies cite the high prices of headsets like the Valve Index (\$999) [16][17] and the HTC Vive Pro 2 (\$1399) [18][19], and opine that purchasing alternative hardware (like computers or physical training equipment) is a more affordable option.	Most workers already have hardware supporting AR (smartphones) in their pockets [20], so few additional purchases are necessary. As for VR hardware, one of the top-selling [21] models – Oculus Quest 2 only costs \$299 [22][23], far below the cost of many low-cost PCs [24] and many types of training equipment. Additionally, the first Oculus Rift Headset (2016) was priced at \$599 [25], so there is a trend towards greater affordability.
2. AR/VR software is only suitable for games and entertainment	In movies, TV shows, ads, and mass media, VR is often depicted as a tool for entertainment and escaping the real world [26]. This creates societal expectations and stereotypes about the technology. As a result, some business leaders refuse to use it for business purposes, fearing that it might impact their reputation and perceived professionalism.	Enterprises already contribute an estimated 33% of global spending on immersive tech solutions [27], and are projected to account for two-thirds of headset sales by 2024 [28]. This points to a high level of acceptance, even if such cases are not publicized as much as consumer-related ones. As for limitations of software use, none of the mainstream AR/VR development tools available today contain exclusively game-focused features and functionality.
3. AR/VR training software quickly becomes obsolete	Some companies are afraid of redundancy, because if their device software becomes outdated and unsupported in the operating system, they will no longer be able to update their app. This has happened with popular headsets like the Google Daydream & Cardboard (2019) [29] and Samsung Gear VR (2020) [30]	While there have been a few disappointing stories of software end-of-life for certain VR platforms, they were mostly connected with poor sales figures or user retention (Daydream [31] and Gear VR [32]). In contrast, commercially successful and well-established products (including the first Oculus Rift from 2016) have received continued support with no termination date [33]). We see a similar situation in AR, with the premiere SDKs (ARCore and ARKit) receiving monthly updates for many years now [34][35].

Misconception	Supporting Points	Rebuttal
<p>4. Immersive training can never replace manual training</p>	<p>According to a survey conducted by Perkins & Coie [36], one of the biggest obstacles to the adoption of AR/VR technologies by businesses is poor content offerings. In other words, the content of the apps may not satisfy business needs. For example, some training operations require serious physical exertion while immersive apps only set simple challenges.</p>	<p>Although today's immersive tech may not let you faithfully simulate lifting and moving heavy objects, you can still do quite a lot of realistic training.</p> <p>For example, work operations that require a high degree of hand-performed precision and certain finger movements can be simulated with VR gloves [37], while user behavior and emotions can be tracked with cameras built into a headset [38].</p>
<p>5. It is cheaper to train in person than to build software</p>	<p>The high development costs of software [15] prompt businesses to calculate whether they will spend less by simply paying experts to train new specialists. In many cases, paying a full year's salary at the average U.S. rate of \$51,480 [39] comes out cheaper than building the app. In many cases, the cost amounts to two years' salaries.</p>	<p>This is not an apt comparison, because:</p> <ol style="list-style-type: none"> 1) trainers are usually very skilled workers whose salaries are higher than average; 2) traditional training involves additional costs – equipment, facilities, safety coordination, etc.; 3) training software can be reused for many years with no updates. While few companies can accurately predict how long a training application will retain its usefulness, the aspects of reusability and logistic convenience should be noted in decision-making.

Examining these points and counterpoints, we can see that some concerns have merit while others are borne from flawed logic or lack of information. For example, it is true that today's immersive apps cannot accurately replicate situations that require great physical exertion. At the same time, the technology is much more popular, versatile, and economically viable than many people give it credit for.

4. WHAT IS THE STATE OF THE IMMERSIVE TRAINING MARKET IN 2021?

Over the past several decades, we have seen numerous tech solutions that promised to create a revolution in their respective industries fail, including Superdrive disks [40], Google Fiber [41], and Kinect [42]. Businesses often seek to increase profit through technological innovation, but tend to be much more cautious with new solutions than consumers, because their investments are larger and much riskier.

With that in mind, what is the vitality of XR training? We can only evaluate the health of this solution by looking at its role and impact on the market.

4.1 Market size and dynamics

The market of VR solutions is currently valued at \$43.1 Billion, while the AR market is valued at \$105.4B, giving a combined total of \$148.5B [43]. Just 4 years ago, the combined market was estimated at \$11.3B [44], so growth of about 12x has taken place. For comparison, the market of 3D printed products (another innovative technology used in business) grew by only 3x in the same period [45].

As for immersive training, it makes up an estimated 19.6% of total spending in the field of AR/VR solutions, with approximately 2.6 million people globally impacted by immersive tech in their work [43]. In 2019, the figure was estimated at only 824 thousand [43]. Accordingly, this means that thousands upon thousands of companies are using it, and many for training purposes.

4.2 Industries using XR Training

In 2019, a survey of 761 business professionals (developers and enterprises) found that the leading industries using XR solutions were education, construction, healthcare, manufacturing, and automotive [46]. Today, the field is much more diverse, with dozens of industries making use of immersive training.

Please note: the industries and examples below are only a sample of the companies and offerings available on the market today.



Agriculture

Simulations in the agricultural field are mostly aimed towards farm and greenhouse workers, including practice caring for crops, field monitoring, and raising livestock.

Use cases:

- Farm navigation training [47]
- Tractor/machinery training [48]
- Drone pilot training [49]
- Farm management training [50]
- Livestock management [51]

Industry leaders:

- John Deere
- Drone Workforce Solutions
- Case IH
- Vaderstad



Automotive

The three key training vectors in this industry are development, production, and servicing. Thus, specialists are taught how to design/produce automobiles and their parts and properly service completed car models.

Use cases:

- Auto repair training [52]
- Assembly training [53]
- Customer experience training [54]
- Auto inspection training [55]
- Automobile design training [56]

Industry leaders:

- Ford
- Volkswagen
- Audi
- BMW



Communication

Immersive solutions integrate seamlessly with telecommunication services to give workers advanced tools and simulations that benefit them in daily maintenance, collaboration, and other operations.

Use cases:

- Communication device training [57]
- Customer support training [57]
- Remote network management training [58]
- Product maintenance training [59]
- Field engineer training [60]

Industry leaders:

- Verizon
- Orange Polska
- Mobile TeleSystems
- De'Longhi



Construction

Construction work involves plenty of risks and hazards, so many training solutions are aimed at providing a safe workplace. Beyond that, they optimize employee cooperation and work efficiency.

Use cases:

- Site navigation training [61]
- Floorplanning training [62]
- Machinery operation training [63]
- Construction skills training [64]
- Workplace safety training [65]

Industry leaders:

- Kelbray
- Brightline Defense
- Robins & Morton
- Clark Construction Group



Energy

Much of the education in the energy industry is aimed at avoiding professional hazards, conducting maintenance, restoring/providing energy service, and operating complex systems/grids.

Use cases:

- Machinery operation training [66]
- Hazard identification training [67]
- Maintenance training [68]
- Workplace environment training [69]
- Site knowledge training [70]

Industry leaders:

- Duke Energy
- Shell
- Consolidated Edison
- Energy Worldnet



Fintech

Banks and financial institutions have relied on high-tech systems for decades, and immersive training is providing new and secure ways to train employees in data processing, safety precautions, and everyday payment procedures.

Use cases:

- Fraud detection training [71]
- Client communication training [72]
- Basic skills training [73]
- Cooperation training [74]
- Branch management training [75]

Industry leaders:

- Bank of America
- Fidelity International
- Goldman Sachs
- Hana Bank



Healthcare

Immersive training is used extensively in healthcare, especially in the fields of surgical procedures, equipment operation, and learning how to care for and interact with patients.

Use cases:

- Surgical training [76]
- High-precision training [77]
- Medical equipment training [78]
- Nursing training [79]
- Emergency response training [80]

Industry leaders:

- University of Virginia Health
- David Geffen School of Medicine
- Riverside Health System
- Chippewa Valley Technical College



Military

Immersive training has a very wide range of uses in this field, simulating combat situations, vehicle and gear utilization, as well as tactical education.

Use cases:

- Combat pilot training [86]
- De-escalation training [87]
- Vehicle maintenance training [88]
- Weapons training [89]
- Medical training [90]

Industry leaders:

- U.S. Air Force
- U.S. Army
- Royal Air Force
- PLA Northern Theater Command



Retail

Immersive solutions in this field are focused on supporting customers, store management and logistics, checkout operations, and data processing.

Use cases:

- Soft skill training [91]
- Health & safety training [92]
- Equipment/machinery training [93]
- Product handling [94]

Industry leaders:

- Walmart
- Amazon
- Lowe's
- Walgreens



Manufacturing

Factory and plant workers can easily use immersive tech to learn and optimize production operations, maintain a high level of safety, and manage the workflow of teams.

Use cases:

- Procedural/documentation training [81]
- Workplace safety training [82]
- Staff onboarding [83]
- Facility navigation training [84]
- Equipment data training [85]

Industry leaders:

- Globalfoundries
- DS Smith Packaging
- Ericsson
- Bosch



Real Estate

Most immersive real estate experiences simulate real houses and buildings, and serve as a valuable reference for agents that need to know the properties well.

Use cases:

- Property tour training [96]
- Staff cooperation training [97]
- Estate presentation training [98]
- Walkthrough simulation training [99]

Industry leaders:

- Compass
- eXp Realty
- Sotheby's International Realty
- Big Block Realty



Transportation

AR/VR solutions in this industry often aim to improve vehicle and inventory handling skills, logistic knowledge, and boost worker safety in various situations.

Use cases:

- Safety hazard training [100]
- Driving skill training [101]
- Aircraft inspection training [102]
- Freight loading training [103]
- Emergency response training [104]

Industry leaders:

- UPS
- Transport Canada
- Celebi Aviation Holding
- XPO Logistics

5. THE FUTURE OF XR TRAINING

By now, consumers and businesses alike have accepted the reality that technological innovation is moving at a staggering pace, and some solutions popular today (like credit cards, external hard drives, charging cables) will become impractical or irrelevant in the near future. Is the prognosis for immersive training positive? Let's take a closer look.

Looking at the forecasts for XR technology in general, analysts are optimistic. For example, the annual production of VR headsets is expected to jump from 8 million units in 2021 to 29 million in 2025 [105]. The same source predicts a 20x increase in AR hardware production.

The XR market as a whole is expected to grow substantially over the next 4 years. Predicted growth rates include 357% [106], 192% [107], and 220% [43].

The forecast in XR training is looking similarly positive. The immersive training market is expected to grow a whopping 946% by 2030 for a total value of \$294.2 billion [43]. The same report puts the number of people using XR at their workplace at 23 million by 2030.

5.1 Upcoming changes in the industry

Statistical predictions based on the past dynamics of the market are helpful to an extent in predicting the longevity of XR training. However, they are vulnerable to sudden events and changes in the industry. For example, continuing support and innovations from hardware manufacturers, SDK developers, investors, and tech giants is absolutely crucial for the survival of XR technologies, and XR training solutions would quickly become outdated without activity and initiative from these figures.

To get a gauge on where this market is going in the next decade, let's examine some of the key events and trends that will have an impact in the coming years

- Google continues regular upgrades to its AR SDK (ARCore) [108], and continues building AR glasses [109]. It has also recently acquired another maker of AR glasses – North [110].
- Apple (the second company with a major AR SDK) continues regular updates to ARKit, and is expected to release its own AR glasses in 2023 [111].
- Other major companies confirmed or believed to be developing AR glasses include Facebook, Xiaomi, Vuzix, and Samsung [112][113].
- Facebook is reportedly already working on a new lineup of Oculus Quest VR headsets [114], while HTC's Vive may soon add an AR/MR device to its lineup [115]. A new Valve VR headset is also believed to be in development [116].
- WebAR (a technology that provides AR experiences in-browser with no app download necessary) is now supported on nearly 3 billion mobile devices, and its use cases are growing rapidly [117].

5.2 A note about the 'Metaverse'

In 2019, a survey of 761 business professionals (developers and enterprises) found that the leading industries using XR solutions were education, construction, healthcare, manufacturing, and automotive [46].

Today, the field is much more diverse, with dozens of industries making use of immersive training.

CONCLUSION

With these points in mind, the role of immersive training will be monumental in the success/performance of thousands of enterprises.

From an economic and practical standpoint, immersive training is a safe investment, and one that can provide benefits for many consecutive years. We should all welcome the avalanche of immersive training solutions that will appear in the coming years, and change the business world forever.

ABOUT PROGRAM-ACE

Program-Ace is an innovation-oriented software development company with decades of experience in building custom enterprise solutions.

We are a market leader in creating immersive solutions for VR, AR, MR, and other platforms.



**HAVE ANY
QUESTIONS?**

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