

Governance Insights Center

Technology series

Emerging technologies



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The Essential Eight technologies

Board byte: augmented and virtual reality

Augmented and virtual reality are no longer figments of the futuristic mind. They're transforming how some companies do business. What should boards know?

Augmented reality (AR) and virtual reality (VR) are moving beyond gaming to other industries. Boards will want to understand whether and how these technologies may impact their company's strategy.

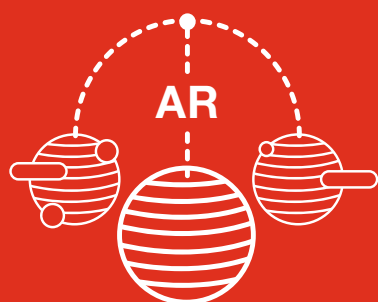
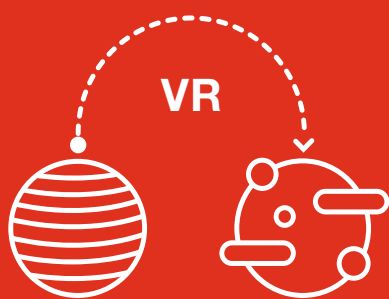


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From the holodeck on Star Trek's Enterprise to Pokemon Go, virtual reality (VR) and augmented reality (AR) have become part of popular culture. While still closely connected to gaming, other industries are exploring how VR and AR and might transform their businesses. This includes medical, automotive, manufacturing, retail, entertainment and even sports industries. They are looking to use the technologies for training, design, collaboration, and media and entertainment purposes.

VR creates a simulated immersive world, while AR technology adds new layers of information to what is real.



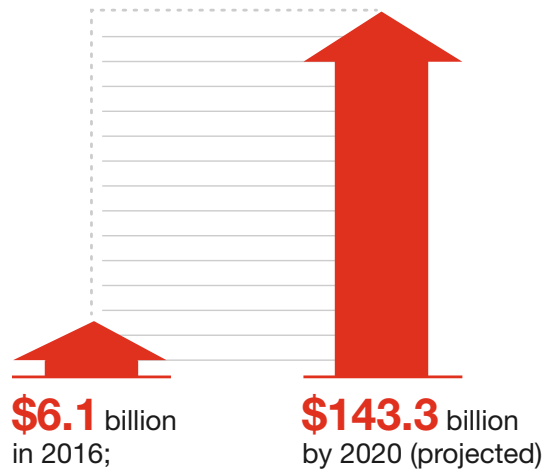
What are VR and AR? VR is a technology that generates highly realistic images and sounds that transport users to *alternative settings*. In this computer-generated simulation of a 3D image or environment, users are immersed in their own "virtual reality" where they can interact with the simulation in realistic ways. AR, on the other hand, provides an experience based on the user's *actual environment*, amplified by computer-generated sensory input, such as sound, video, graphics or location data.

A reality check on the AR and VR markets

After analyzing more than 150 emerging technologies, PwC categorizes VR and AR as two of the [Essential Eight](#) technologies. The market for these technologies is growing, with worldwide spending projected to total more than \$140 billion by 2020.¹



Worldwide spending for augmented-reality and virtual-reality market



Source: IDC, February 2017

VR is still most common in the gaming industry. Players can experience games in a three-dimensional environment, interacting with their surroundings as they play. But companies in other industries are exploring VR investments as well. Some are looking for ways to improve design and product development processes with computer simulation. Others are using VR to improve customer experiences or innovate their products, services and business models. For example, in medicine, manufacturing and even sports, VR allows doctors, workers and athletes to undergo new kinds of training. In VR, they can experience hazardous, difficult or cost-prohibitive situations without the risks they would pose in the “real world.”

Virtual reality is also changing marketing and communications across industries. VR simulation can give customers a hands-on, up-close and interactive experience with a product. This may be an experience that is not available in the real world. And the virtual interaction can provide an emotional connection to the product. Marketing teams can use VR to connect with customers, stand out among competitors, and analyze purchasing decisions and behaviors. Automakers are also starting to use VR as they design and build vehicles. Some are also using it in the buying experience, giving customers a new way to research cars.





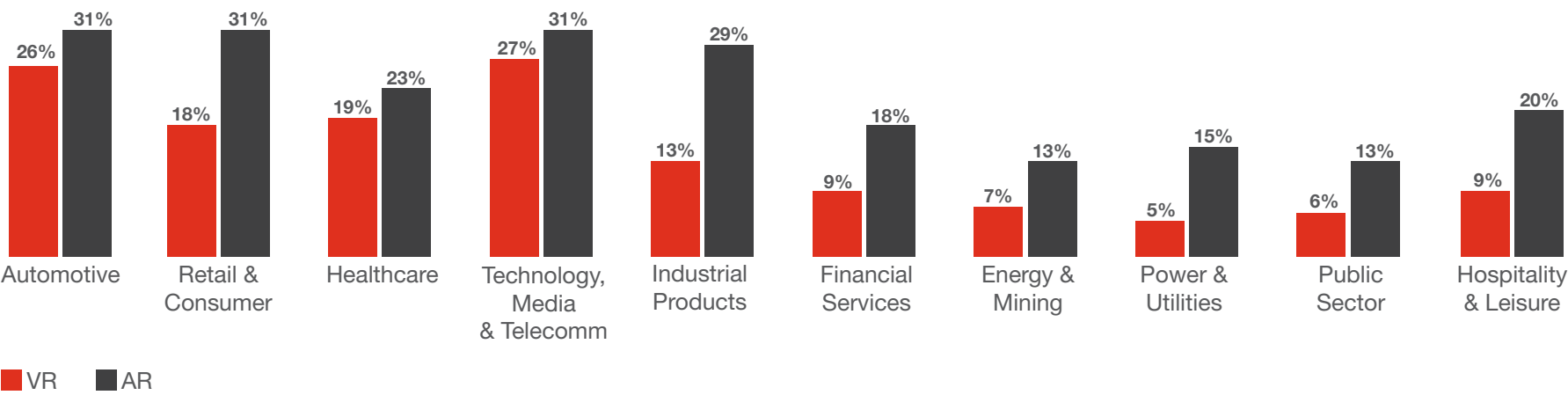
AR bridges the digital and physical worlds. Companies are starting to use AR to enhance the customer and employee experience. For example, car companies are using AR to display driving information on the windshield. This improves both safety and the driving experience.

This is just the beginning. AR can also help improve logistics and product design, particularly in manufacturing. Airline manufacturers are using AR to assemble parts faster and with more accuracy. AR also has the potential to change retail. As customers enter a store, they can also enter their own unique experience. By blending digital and physical shopping, AR may lead the way to better personalization and improved customer engagement.

Many of the big technology companies, smart phone makers, and software companies are making significant investments in AR tools, platforms and services. They believe AR will be one of the next big computing platforms and that investment now will pay off later.

Virtual reality and augmented reality investment by industry in three years

Which technologies are you making substantial investments in?



Source: PwC, 2017 Global Digital IQ® Survey. Bases: Automotive: 72; Energy & Mining: 135; Financial Services: 332; Healthcare: 237; Hospitality & Leisure: 75; Industrial Products: 375; Power & Utilities: 131; Public Sector: 156; Retail & Consumer: 217; Technology, Media & Telecommunications: 433



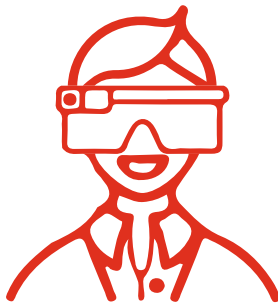
VR and AR in action now – and in the future



Go to the Super Bowl – without leaving the couch:

Augmented reality is already an established presence in sports – think about all of the computer-generated ball-tracing graphics that show football plays or golf shots. VR is also opening up a new

revenue stream: fans who want to experience the game but aren't at the stadium. Some professional sporting events are already broadcast in VR, allowing fans to choose their digital seats and move around the field to see the game from different vantage points – using virtual headsets in their living rooms. Some are also planning to use VR for athlete training and game analysis.



Sporting smartglasses in the workplace:

Many manufacturers have started to bring smartglasses into their factories and plants – and with those smartglasses, augmented reality. These wearable computers provide information tailored to the worker's context

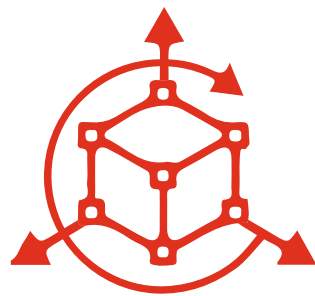
and space. By just looking at a shelf, a worker can see data through the glasses about what is stored there. Smartglasses can also help when it comes to assembly instructions or equipment repair. They show step-by-step instructions in the wearer's field of view, freeing up the worker's hands to actually assemble or repair the goods. It's estimated that more than 14 million workers will wear smartglasses by 2025, up from 400,000 in 2016.²



Augmented interior design and virtual DIY:

Updating your kitchen? Customers at Lowe's can experience the remodel well before demolition starts. With an AR headset, they can see different design options for their next big project. Lowe's also has a "[Holoroom How To](#)," an on-demand virtual reality clinic for all the DIY-ers looking to hone their home improvement skills.

Ikea customers can use an augmented reality app on their mobile device to overlay items – furniture, décor and more – directly into their homes. This allows customers to see how things will look in their living and dining rooms before going to the store or making a purchase. The app shows furniture to scale and even allows a 360-degree view. These features help customers – and the store – by reducing the number of product returns.



From 2D to 3D in the hospital:

Medical communities are considering the ways VR and AR can improve research, education, training and the patient experience. With augmented reality, studying anatomy will become a three-dimensional exercise, enabling students to peel away layers of the body to study images of bones, organs and the brain. In the hospital, AR headsets can help surgeons see procedures as they unfold, and nurses can use them to find veins more easily. Instead of learning by observation, surgical residents could use VR simulation training to practice as they prepare for the real thing. VR may have potential to improve the quality of life for bedridden or Alzheimer's patients. And it could easily provide patients with different environments for tedious physical and occupational therapy.



Adoption benefits and barriers

Like any new technology, companies and boards need to understand the pros and cons of adoption. VR and AR can open the door to new business model possibilities for companies, as well as new products and services. Some other benefits of AR and VR may include faster prototyping, enhanced design and training, risk-free exploration, increased efficiencies, improved safety and cost savings.

But there are also challenges. For starters, many companies lack the digital skills needed to fully execute on these technologies. They also face highly fragmented and inconsistent capabilities across hardware platforms and operating systems. Creating virtual content requires expertise and the right technology. There are also technical barriers due to the lack of maturity in this area related to optics and 3D capabilities. Cost is another issue – it can be expensive to procure and own devices. The lack of standards to describe information, share data and integrate systems is another hurdle to adoption.

There are also operational risks that come with adopting VR or AR. Introducing new hardware, securing data and maintaining and repairing systems is difficult and expensive. And the technologies may pose security, privacy and legal intellectual property issues.



Questions boards should ask management about VR and AR

Boards will want to keep abreast of the opportunities and risks that come with VR and AR. Here's what boards can ask management about how VR and AR might fit into the company's strategy:

- ⊕ How might AR and VR impact our company's products or services? What new business opportunities could these technologies create?
- ⊕ Are our competitors starting to use AR and VR technologies? If so, how?
- ⊕ Can we use AR and VR to improve our business processes, such as logistics, maintenance and marketing, or to enhance employee training and experiences?
- ⊕ Do we have the talent in our workforce to execute on these technologies? How can we increase the skills of our workforce related to these technologies?
- ⊕ Do we understand the hurdles to adoption and use of these technologies, including necessary upgrades in hardware and operating systems?

With a basic understanding of virtual reality, augmented reality and the other Essential Eight technologies, boards can better oversee management's decisions in these areas. And they can be more effective at evaluating the related strategic opportunities.

For more resources on what boards should know about the Essential Eight and digital transformation, go to our website, [***Technology hub: insights for board members***](#). And find additional [***resources on VR, on AR***](#) and emerging technologies on PwC's [***Next in Tech***](#) hub.

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¹ IDC, “Worldwide Spending on Augmented and Virtual Reality Forecast to Reach \$13.9 Billion in 2017, According to IDC,” February 27, 2017.

² Forrester, “How Enterprise Smart Glasses Will Drive Workforce Enablement,” April 21, 2016.

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