The Future of VR & AR

Fresh Consulting
freshconsulting.com

Table of Contents

3 Leveraging the Power of Virtual and Augmented Reality

7 The Current State of the Industry

10 Key Players and Technologies in the VR and AR Industries

17 Industry Applications, Use Cases, and Examples

28 Act Early on the Potential of VR/AR

Image Source: Wikipedia

Leveraging the Power of Virtual and Augmented Reality

You've likely seen – or even tried out – a virtual reality (VR) headset at some point in the last few years. You've probably seen announcements about augmented reality (AR) capabilities that are now embedded in newer smartphones. This is because augmented, virtual, and mixed reality (MR) technologies are becoming more affordable and widespread, and the demand for the technology and people who can create it is high.

As augmented and virtual reality experiences are making their way into mainstream culture, the specific impact they will have on our lives and workplaces is becoming more and more obvious. Industries like healthcare and entertainment are already benefiting from the possibilities created by AR and VR. Statistics show that these technologies will continue to play an important role in other industries like retail, marketing, education, construction, real estate, and entertainment, among many others.

Many businesses leverage virtual and augmented reality to make their workplaces more productive and engaging. These technologies are also being improved for marketing purposes. VR and AR have the potential to provide immersive experiences that give consumers a one-of-a-kind taste of what businesses offer. Mixed reality can also be used to layer additional information onto a natural environment to make it more informative, safer, and more efficient.

This paper explores the immense potential of virtual and augmented reality to help you understand where the industry is going and what your business stands to gain from investing in this technology early on.

Virtual Reality (VR):

"an interactive computer-generated experience taking place within a simulated environment. It incorporates mainly auditory and visual feedback, but may also allow other types of sensory feedback like haptic. This immersive environment can be similar to the real world or it can be fantastical." [1]

Augmented Reality (AR):

"an interactive experience of a real-world environment where the real-world is "augmented" by computer-generated perceptual information, sometimes across multiple sensory modalities, such as visual, auditory, and haptic. [2]

Mixed Reality (MR):

Mixed Reality (MR): the merging of both real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time. [3]

Extended Reality (XR):

a term referring to all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables.[4]

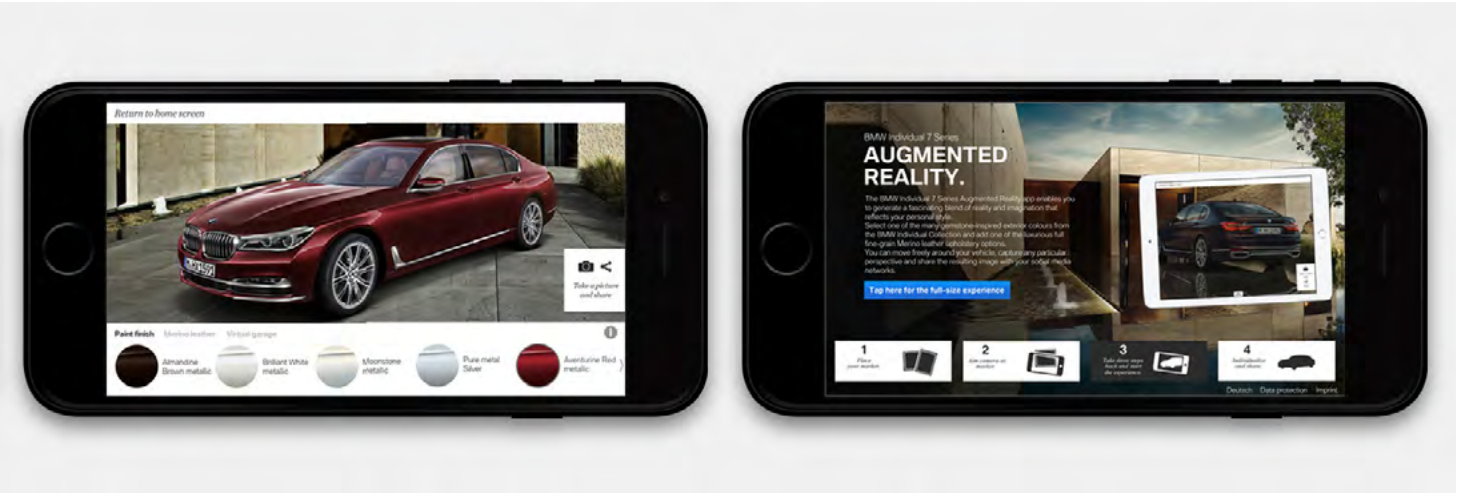

Image Source: BMW

If what DigiCapital writes is true – that "VR is for games [and] AR is for everything – AR will likely more widespread application. Whatever the case, we contend that both VR and AR have a future that is worth understanding and investing in.

The Current State of the Industry

It doesn't seem like that long ago that we were hearing rumors of Google's latest prototype, Google Glass, a pair of glasses that allowed the wearer to see digital information and programs overlayed on top of their natural surroundings. While Google Glass was an early-stage prototype that didn't take off as expected, it paved the way for other companies to improve upon Google Glass' mishaps.

We've seen the immense popularity of augmented and virtual reality in games like PokemonGo that hit worldwide adoption in record time, developer toolkits like Apple's ARKit that was recently announced, and office AR headsets like Microsoft HoloLens that continue to be developed and expanded.

Image Source: Pokemon

What started out as the pet project of a few large tech companies has quickly turned into a serious focus on creating the next iteration of technology. In 2014, Facebook purchased Oculus for 2B, and the company now has hundreds of employees dedicated to the development of VR products and software. HTC partnered with Valve and together created the HTC Vive, a high-end VR system which offers one of the most advanced room-space tracking systems to-date. Google, Apple, Amazon, Microsoft, Sony, Samsung, and Intel all have internal groups devoted to AR and VR work. In one of the largest fundraising efforts for an AR/VR startup, Magic Leap has raised 2.4B to date, with 542 million of that coming from Google. [5][6] It's expected that the global AR and VR market size could reach $209 billion by 2022.[7]

Market Statistics

• In 2017, the consumer industry spent $6.2 billion on AR; the discrete manufacturing and retail industries each spent $1.5 billion on AR, and the process manufacturing industry spent $700 million.[8]

• IDC reports "Spending on AR/VR products and services is forecast to reach $27 billion in 2018" [9]

• Deloitte reported that 88 percent of mid-market companies were using a form of virtual or augmented reality in their business.[10]

• 24 million virtual reality and augmented reality devices are expected to be sold in 2018 alone.[11]

• Device shipments by the end of 2018 are predicted to reach 2 million for Sony, 900k for Oculus, 600k for HTC, 150k for Microsoft, and 1 million for all remaining vendors combined.[12]

• In 2018, consumers are accessing VR/AR technologies on these devices: smartphone 77%, PC or console 35%, standalone 35%.[13]

Market Projections

• The global VR and AR market is predicted to attain a compound annual growth rate (CAGR) of 71.6% between 2017-2022.[14]

• 22.8 million AR glasses are predicted to be shipped by 2022.[15]

• Statista predicts 100 million VR headsets worldwide in 2021.[16]

• By 2020, sales revenue for VR gaming is predicted to reach $22.9 billion worldwide.[17]

• The VR market is predicted to be worth $33 billion by 2022.[18]

• The market for VR & AR technologies is predicted to reach $94.4 billion in value by 2023.[19]

• Citi predicts a trillion dollar industry by the year 2035.[20]

Key Players and Technologies in the VR and AR Industries

Facebook/Oculus (Rift, Go, and Quest)

In 2014, Facebook acquired Oculus, a VR company that focuses on making headsets and VR software for developers.[21] Oculus created the popular Oculus Rift and Oculus Go headsets and the upcoming Oculus Quest, the first all-in-one VR gaming system.[22][23][24] Oculus was one of the first VR companies to gain significant public support, and since then they have worked to streamline their headsets while also producing games, instructionals, and entertainment software for the device. While the primary goal of the company is to make products centered around the gaming industry, they are also working on areas like 3D video and photography and are rumored to be working on AR devices as well.[25][26]

Image Source: Oculus

HTC and Valve Corporation (HTC Vive Pro)

The HTC Vive is a collaborative virtual reality system made by Valve (the creators of the Steam digital game store) and HTC (a high-end consumer electronics company).[27] [28] [29] [30] Together, they offer the standard Vive headset alongside an enhanced Vive Pro version. Each is relatively affordable compared to competing products, with the focus being on the entertainment and gaming industries. Both headsets support motion tracking via the highly accurate Lighthouse tracking system, which offers one of the best room-scale VR experiences. HTC and Valve continue to work together, with the goal of bringing VR to mainstream audiences as quickly as possible, while continuing to produce high-quality yet affordable products.[31]

Image Source: Vive

Google (Daydream and Cardboard)

Daydream is a lightweight VR headset that is compatible with many mobile devices.[32] Aside from enabling developers to create immersive VR experiences through YouTube videos and mobile apps, the VR headset has enabled many humanistic and educational projects, including an empathetic look at female leadership in The Female Planet, an augmented reality CPR trainer, and Ocean to Plate, an immersive documentary about the fishing industry supply chain.[33] [34] [35]

Cardboard is Google's virtual reality headset made out of– you guessed it– cardboard.[36] By keeping the product simple and affordable, Google has been able to reach a large number of individuals with VR. Along with giving consumers an affordable VR headset, they are using it to promote initiatives like Google Expeditions (a way for students to take field trips without leaving the classroom) and Google Jump (a camera built for recording in 3D).[37] [38]

Image Source: Google VR

Apple (ARKit)

It's been rumored that Apple is working on their own AR glasses.[39] But prior to releasing their own product, in 2017, Apple released ARKit as a feature included in iOS 11.[40] ARKit is a development tool that makes creating AR apps for iOS devices simple. Because AR is now built into the operating system, apps that use ARKit are more stable and powerful than before. Aside from popular games like PokemonGo, developers have used ARKit to create apps that let users measure distance in real time and see how furniture will look in their homes before purchasing it.

Microsoft (HoloLens)

HoloLens is a mixed reality project by Microsoft that is geared towards enterprise use. While most AR/VR headsets require a connection to a computer, controllers, and more, the HoloLens is an all-in-one product, so the user only needs the headset.[42] It runs on Windows 10 and uses the Mixed Reality features built into the operating system. The unit currently costs $5,000 due to how technologically dense it is, so, for now, Microsoft is offering to rent it to businesses until it becomes more affordable.[43]

Magic Leap (Magic Leap One)

Magic Leap is a startup company that makes high-quality MR headsets.[44] What sets them apart from similar products is their intense focus on immersion.[45] The device uses light fields to create AR projections directly on the wearer's eyes, making digital artifacts extremely realistic and believable. Each Magic Leap One headset comes with a controller and a "Lightpack" that fits in your pocket, so the system is completely wearable.[46] While most of their projects are still in development, they have shown a lot of promise and received widespread support from the industry.[47]

Samsung (Gear VR)

Samsung's Gear VR, first released in 2015, is a virtual reality headset that uses a Samsung phone as the screen.[48] Samsung first started working on the concept of a mounted headset back in 2005 and partnered with Oculus in 2014 to bring the device to life. Because it uses the wearer's phone for a screen, it's available at a much lower cost than its competitors.[49] Users can download apps and games from Oculus Home (Oculus' app store), mount their phone onto the headset, and use the device with peripherals like headphones and controllers.[50]

Image Source: Samsung

Huawei

Huawei announced that they plan to release their own version of AR glasses in one to two years.[51] Despite the previous failure of Google to create a pair of augmented reality glasses that saw mass adoption, Huawei believes the market for AR technology is still in its infancy.

Intel

Intel also began developing a pair of smart glasses but decided to scrap the project, saying the market didn't support further investment.[52] The company has instead invested in developing their VR-ready PCs, processors that support the demands of VR technology, and the Intel VR True headset which focuses on bringing sporting events to life.[53]

PlayStation (PlayStation VR)

Gaming has been a primary focus of early VR developers, and PlayStation is at the forefront. Their PlayStation VR system already has over 200 games that work with the PS4 system.[54]

Image Source: PlayStation VR

Mira (Mira Prism)

The Mira Prism is a unique AR tool that enables you to turn any smartphone into an AR device.[55] The prism is a plastic shell to which you can attach your phone. Images from a compatible app on your phone are projected onto the prism and reflected back into your field of vision, as you look around your environment.

Meta (Meta 2 AR Development Kit)

Meta aims to create a comprehensive AR development kit with their Meta 2 AR headset and the accompanying Meta Workspace™ software.[56] The company hopes to make creativity and design more immersive, as they illustrate in their concept video that demonstrates how a Nike sneaker could be designed through their AR headset.[57]

Industry Applications, Use Cases, and Examples

Reading statistics and trends about the high profile companies that are currently working on the future of virtual and augmented reality, but the actual usefulness or application of this technology might not be immediately apparent. In fact, most of the well-publicized uses of VR and AR are currently confined to small niches in the gaming and entertainment industries. But the technology is actually applicable in a much wider range of scenarios.

The AR/VR journey to the mainstream will probably be similar to the personal computer many of us carry in our pockets. The personal computer industry began its journey in the form of unwieldy, large and expensive machines used by large corporations to perform batch processes. In 1977, computers made their way into people's homes through entertainment systems like the Atari 2600, and by the mid-90s, the personal computing phenomenon was in full swing.

Today, many of us won't leave the house without a computer in our pockets – the omnipresent smartphone. Just as the beginning signs of the impact personal computers would have on modern life emerged in the 1980s, today, the coming wave of VR and AR technology is becoming clearer. Consider the following summary of current and near-future uses for VR, AR, and MR technologies that are paving the way for many industries.

Healthcare

• Surgeons can use virtual reality to operate on patients remotely by using a VR console that controls a robot in another location. [58] This robot mimics the surgeon's movements, allowing them to treat patients around the world without either of them needing to travel.

• Surgeons wearing headsets like Google Glass can live stream the surgery to other surgeons around the world, allowing them to collaborate and share information during every step of the operation.[59]

• Doctors have used AR programs by companies like Medsights Tech to create 3D reconstructions of MRI results directly on a patient's body, giving them the ability to pinpoint the location of medical issues like tumors without the need for radiation exposure.[60]

• Virtual reality has been used to treat phobias (such as fears of heights, storms, or flying) in patients by simulating their fears in a safe and controlled environment.[61]

• Award-winning VR game DEEP uses the player's breathing and movements to determine the game experience.[62] Players explore a calming underwater world while practicing breathing and relaxation meditation techniques. It's been shown to be effective for reducing stress in individuals with anxiety and other stress-related issues.

• Virtual reality can also be used to conduct studies in psychology by giving psychologists a greater level of control over what their subjects experience.

Retail and Marketing

• Using AR to see what furniture and other products will look like in a prospective buyer's home has become increasingly popular among consumers.[63] Companies can create a 3D model of a product and incorporate it into their app, giving users a retail shopping experience in their home.

Image Source: Amazon

• Simmons introduced the SIMulator app in 2014, which allows in-store mattress shoppers to point their phone at products and watch interactive animations that provide them with insights into the product they're considering purchasing, reducing the need to speak with sales personnel.[64]

• Some post offices and greeting card companies have incorporated augmented reality triggers that prompt playful animations as users engage in an app.[65]

Business and Education

• Similar to the way we use Skype to have meetings with coworkers around the world, augmented reality headsets will allow us to have "in person" meetings between individuals thousands of miles apart.[66]

• New employees and potential hires will soon be able to prove their skills in a simulated experience rather than a written or practical test. [67]

• Products like Microsoft's HoloLens use "holograms" to create a computing experience that resembles that interface that Tony Stark might see looking out from his Iron Man suit. [68] Microsoft believes that working and collaborating on systems like this will be more natural and intuitive than today's standard computers. [69]

• There are several emerging software companies with the goal of making the education experience more accessible and immersive through virtual reality. [70]

• News networks have started to use virtual reality to bring viewers closer to the action of live events like political debates, interviews, and more. [71]

Arts and Entertainment

• Using virtual reality, concert and theater "goers" can attend events without leaving home.[72] Venues and sports stadiums would be able to sell virtual tickets alongside physical tickets, allowing more people to attend the event than currently possible.

• Watching television on a VR/AR headset would allow for much more captivating experiences, such as turning your living room into a screen or putting you in the helmet of your favorite football player.[73]

• VR creates the opportunity for new mediums of art and entertainment that are much more immersive than anything before, such as virtual sculptures and VR films. [74] [75]

Gaming

• Virtual and augmented reality has already had a huge impact on the gaming industry, and it hasn't shown any signs of slowing down. As more platforms adopt the technology, the gap between players and their favorite characters will continue to shrink. [76]

• Cross-platform favorites like Skyrim, Doom, and Fallout 4 have been released for the PlayStation VR system. [77] VR game-makers have come up with many creative ways to use the technology. The Invisible Hours allows players to be immersed in a murder mystery. [78] Audioshield sends music beats flying at you, which you smash for a great workout and visual music experience. Dark Days makes you a character in a psychological thriller.

Construction

• AR could be used to overlay notes on a construction site, making communication and coordination easier. [79] It could eventually be combined with building information modeling software to make visualization of construction projects much more powerful. [80]

• 3D building modeling would allow designers to visualize and collaborate on building designs more easily. [81]

Military

• The military can rehearse simulations of combat and rescue missions before deploying soldiers without putting anyone in any danger. [82]

• Artificial reality can help people practice cultural sensitivity before going to a different country. [83] Programs like this are already being used by the military to prepare individuals for deployment.

• The military is using street view data and satellite imagery to recreate real cities and train soldiers to navigate them. [84]

Image Source: VR Vision

Travel and Tourism

• Travel companies, hotels, and real estate agents can give virtual tours remotely, allowing potential customers to preview a space before making a final decision. [85]

• Programs like Google Expeditions give students the opportunity to take field trips to monuments, landscapes, and museums around the world without ever leaving the classroom. [86]

• Yelp has an AR feature called Yelp Monocle that allows app users to get business information when they point their phone at a particular business. [87]

• Google Translate incorporates an AR feature that provides translations when a smartphone's camera is pointed toward text displays like signs or menus. [88]

Automotive

• Head-up displays project useful information on car windshields, including information about directions, speed, and warning messages. [89]

• BMW presented a concept for a motorcycle visor that would project information about riding line and lean angles into the rider's view. [90]

Industrial and Manufacturing

• Evolar developed wearable AR technology that helps warehouse workers locate and sort inventory. [91]

• According to PWC, improved product design is currently the most widespread application of VR/AR technology among manufacturing companies. [92]

• VR and AR are also being used for safety and training, where virtually-enhanced experiences allow trainees to learn the material in a more immediate and realistic context.[93]

Fashion

• At the 2016 London Fashion Week, Lyst (an online fashion company) created an exhibit where attendees could "dress" models using AR.[94]

• Forbes predicts the ability to visualize fashion and retail products remotely will be key to some retailers' success in the future. For instance, 20 million people have downloaded Makeup Genius, L'Oreal's app that lets users try on makeup virtually. [95]

Music

• Kasabian created a 360-degree VR experience that allowed fans to be on stage with the band during a virtual performance.[96] In 2014, Kasabian fans got the chance to see the band in virtual reality.

• Firstage, an Irish startup, has made it possible to simulate watching a band live from the comfort of your home, using an AR smartphone app, a small printed "stage", and musical performances pre-recorded in front of a green screen.[97]

• Björk created Björk Digital, an art exhibition that includes a variety of VR headset experiences, including a concert that was filmed inside the performer's mouth. [98]

The Future State of the Industry

As technology continues to advance at a rapid rate, VR and AR's role in the way we interact with the world will grow.

For example, reaching consumers in new ways will be imperative for a variety of industries. AR and MR technologies can be used anywhere we work or play today. Any XR technologies can make distance less of a barrier, offering the ability to interact and communicate in ways that were not possible before.

Health professionals will be able to treat patients in a more personal manner and improve current practices through AR implementation; students will be able to learn in a more immersive and engaging way with VR courses; employees will be able to work together in more productive and natural environments that don't confine work to a desk; and mixed reality experiences will make entertainment, news, and art more compelling for audiences.

The core of any prediction above is that the influence of VR and AR will continue to grow, and staying on the leading edge of innovation will be advantageous for companies and industries that are prepared.

How It Will Affect Consumers

The barrier between consumers and their devices is much smaller now than it used to be. We've gone from keyboard-only computers to keyboard and mouse, to touch screen interfaces. Users have the ability to interact with software directly.

However, there is still a "middleman" – a device that we use to access these applications. While we've nearly perfected this device, it still limits programs to a device's physical hardware; programs can't fully extend beyond the screen or integrate with our physical environment in a way that VR and AR will allow them to.

With XR, the line between the digital world and the physical one begins to blur to an even greater extent. Using this technology, businesses will be able to provide consumers with at-home experiences similar to in-person experiences. E-commerce is already widespread and the advances with AR/VR will continue to accelerate that movement.

How It Will Affect Businesses and Work

For the past few decades, businesses have been striving to create open spaces for office workers to improve productivity and reduce the amount of time employees spend sitting at desks.

With VR and AR, we can work in digital spaces that are completely open, utilize the natural space around us, and collaborate with others in ways that weren't previously possible. Teams will be able to meet and work together from different parts of the world through telepresence. Resources could be made available virtually instead of physically. Product designers will be able to work with each other by visualizing projects in 3D spaces, reducing the costs of physical prototyping and easing collaboration.

Augmented reality will likely eliminate some need for context switching. For example, information could be overlaid on a screen as an employee works so that they can stay immersed in their task rather than jumping between multiple windows in a computer.

Act Early on the Potential of VR/AR

XR related technologies offer the potential to create a seamless experience between the way we interact with computers, devices and the world around us. This will soon have a substantial impact on both our personal and work lives and reshape countless industries.

Keeping in mind that Facebook paid $2 billion for Oculus, here's what Mark Zuckerberg said when people doubted the future of Virtual Reality:

> "I think people tend to be worried about every new technology that comes along. Critics worry that if we spend time paying attention to that new kind of media or technology instead of talking to each other [it's] somehow isolating. But humans are fundamentally social. So I think in reality, if a technology doesn't actually help us socially understand each other better, it isn't going to catch on and succeed.
>
> You could probably go all the way back to the first books. I bet people said 'why should you read when you could talk to other people?' The point of reading is that you get to deeply immerse yourself in a person's perspective. Right? Same thing with newspapers or phones or TVs. Soon it will be VR, I bet."[99]

Humans are not only fundamentally social, but we're also fundamentally productive and collaborative. Add to that we love to be entertained, and you can quickly see how XR technology strikes at the center of all of these natural tendencies.

By being proactive and creative in thinking about the possibilities that AR, VR, and MR provide, businesses can create more immersive experiences for consumers, improve employee productivity, and reduce costs through more efficient workflows.

The examples covered in this paper are only a starting point for a conversation about the future of virtual and augmented reality. All of these benefits are available now to businesses who invest in learning what virtual reality and augmented reality can do for them, surf this technology wave as opposed to getting crushed by it.

Businesses that invest now have the opportunity to be on the cutting edge of your industry to truly make these technological benefits a reality today. Those who do can prepare themselves for growth and opportunities for innovation.

References

[1] "Virtual Reality." Wikipedia, Wikimedia Foundation, 22 Nov. 2018.

[2] "Augmented Reality." Wikipedia, Wikimedia Foundation, 27 Nov. 2018.

[3] "Mixed Reality." Wikipedia, Wikimedia Foundation, 19 Oct. 2018.

[4] "Extended Reality." Wikipedia, Wikimedia Foundation, 3 Oct. 2018.

[5] "Magic Leap." Crunchbase, 2018.

[6] Spangler, Todd. "Magic Leap Raises $542 Million from Google, Legendary and Others." Variety, 22 Oct. 2014.

[7] "Global Augmented/Virtual Reality Market Size 2016-2022 | Statistic." Statista, 2018.

[8] "AR/VR Spending Worldwide by Segment 2017 | Statistic." Statista, 2018.

[9] "Worldwide Spending on Augmented and Virtual Reality to Achieve a Five-Year CAGR of 71.6% by 2022, According to IDC." IDC: The Premier Global Market Intelligence Company.

[10] Downing, Jason W. "2018 Mid-Market Technology Trends Report | Deloitte US." Deloitte United States, 14 Sept. 2018.

[11] Koytcheva, Marina. "Augmented and Virtual Reality Devices to Become a $4 Billion-Plus Business in Three Years." CCS Insight, 2018.

[12] "VR Device Shipments by Vendor Worldwide 2017-2018 | Statistic." Statista, 2018.

[13] "Share of VR/AR Users U.S. by Device 2018 | Statistic." Statista, 2018.

[14] "Worldwide Spending on Augmented and Virtual Reality to Achieve a Five-Year CAGR of 71.6% by 2022, According to IDC." IDC: The Premier Global Market Intelligence Company, 2018.

[15] "Tractica: Natural Language Processing Market to Reach $22.3B by 2025." InnovatioNews, 22 Aug. 2017.

[16] "Virtual Reality Headsets Worldwide 2016-2021 | Statistic." Statista, 2018.

[17] "Global VR Gaming Market Size 2020 | Statistic." Statista, 2018.

[18] "Virtual Reality Market Size Is Projected to Be Around US$ 33 Billion by 2022." MarketWatch, MarketWatch, 31 Aug. 2018.

[19] Markets, Research and. "Global Augmented Reality (AR) and Virtual Reality (VR) Market Is Forecast to Reach $94.4 Billion by 2023 - Soaring Demand for AR & VR in the Retail & E-Commerce Sectors." PR Newswire: News Distribution, Targeting and Monitoring, 31 July 2018.

[20] Graham, Luke. "Citi Eyes a Trillion-Dollar Industry in Virtual Reality Technology." CNBC, CNBC, 14 Oct. 2016.

[21] "Oculus." Oculus, 2018.

[22] "Oculus Rift | Oculus." Oculus, 2018.

[23] "Oculus Go | Oculus." Oculus, 2018.

[24] "Oculus Quest | Oculus." Oculus, 2018.

[25] "What Is Oculus Rift? - FAQ - How Oculus Rift Works." Tom's Guide, 28 Mar. 2016.

[26] Carbotte, Kevin. "Is Oculus Preparing To Announce An AR Device?" Tom's Hardware, 20 Apr. 2018.

[27] "VIVE VR SYSTEM." Vive, 2018.

[28] "About Us." Valve Corporation, 2018.

[29] "Welcome to Steam." Steam, 2018.

[30] "VIVE VR SYSTEM." Vive, 2018.

[31] Lang, Ben. "HTC Vive Headset Nearing 100,000 Sales." Road to VR, 7 July 2016.

[32] "Daydream." Google VR, Google, 2018.

[33] "Daydream Impact - The Female Planet." Google VR, Google, 2018.

[34] "Daydream Impact - American Heart Association." Google VR, Google, 2018.

[35] "Daydream Impact - Ocean to Plate." Google VR, Google, 2018.

[36] "Cardboard | Google VR | Google Developers." Google, Google, 2018.

[37] "Bring Your Lessons to Life with Expeditions | Google for Education." Google Expeditions, Google, 2018.

[38] "Jump." Google VR, Google, 2018.

[39] Lynch, Gerald. "Apple AR Glasses Release Date, News and Rumors." TechRadar, 30 Aug. 2018.

[40] "ARKit 2 | Using 2D and 3D Transforms." Apple, 2018.

[41] Fitzsimmons, Michelle. "What Is ARKit 2? Here's What You Need to Know about Apple's Latest AR Update." TechRadar, 4 June 2018.

[42] "Microsoft Hololens." Microsoft, 2018.

[43] Matney, Lucas. "Microsoft's HoloLens Is Now Available to Rent." TechCrunch, 14 Feb. 2018.

[44] "Magic in the Making." Magic Leap, 2018.

[45] Huet, Ellen. "Magic Leap CEO: Augmented Reality Could Replace Smartphones." Forbes, 24 Feb. 2015.

[46] "Magic Leap One: Creator Edition | Magic Leap." Magic Leap, 2018.

[47] "Magic Leap One: Creator Edition | Magic Leap." Magic Leap, 2018.

[48] "Samsung Gear VR with Controller." Samsung UK, 2018.

[49] Smith, Chris. "Samsung Gear VR Consumer Edition Goes on Sale in the US." Trusted Reviews, 20 Nov. 2015.

[50] Stein, Scott. "Samsung's Gear VR May Be the Galaxy S8's Greatest Fringe Benefit." CNET, 26 Mar. 2017.

[51] Kharpal, Arjun. "Chinese Tech Giant Huawei Plans to Introduce 'Augmented Reality' Glasses in next One or Two Years." CNBC, 14 Nov. 2018.

[52] Bohn, Dieter. "Intel Is Giving up on Its Smart Glasses." The Verge, 19 Apr. 2018.

[53] "Intel® True VR Technology." Intel, 2018.

[54] "PlayStation VR - Over 200 Games and Counting. Feel Them All." PlayStation, 2018.

[55] "Mira Augmented Reality." Mira Augmented Reality, 2018.

[56] "Meta | Augmented Reality"Meta Augmented Reality, 2018.

[57] Strange, Adario. "The Future of Nike Design Looks Amazing in This Concept Video." Mashable, 16 May 2017.

[58] Eveleth, Rose. "Future - The Surgeon Who Operates from 400km Away." BBC News, BBC, 16 May 2014.

[59] Schijven, Marlies. "Wearable Technology at the OR during Laparoscopic Surgery Using TedCas Myo." Google Glass Surgeon, 2018.

[60] "The Top 9 Augmented Reality Companies in Healthcare." The Medical Futurist, 4 July 2018.

[61] "Virtual Reality Therapy for Phobias." Duke Psychiatry and Behavioral Sciences, 1 Aug. 2018.

[62] "DEEP." Owen LL Harris, 2018.

[63] "Amazon Is Using AR To Help People See Before They Buy." PSFK, 8 Nov. 2017.

[64] "Simmons Strengthens Commitment To Innovation With New Digital Selling Tools And Expanded Comforpedic IQ™ Line." Simmons, 2018.

[65] "Amazon Is Using AR To Help People See Before They Buy." PSFK, 8 Nov. 2017.

[66] Kasriel, Stephane. "This Is What Your Future Virtual-Reality Office Will Be Like." Fast Company, 18 July 2017.

[67] Bozorgzadeh, Amir. "You'll Be Prepping for Your next Job Interview in VR." VentureBeat, 25 July 2016.

[68] "HoloLens | Holo Lens Studio Demo | Windows 10 | Microsoft HoloLens." Microsoft, 21 Jan. 2015.

[69] Carson, Erin. "Microsoft HoloLens: What Does It Mean for Business?" TechRepublic, 2018.

[70] Reede, Elizabeth, and Larissa Bailiff. “When Virtual Reality Meets Education.” TechCrunch, 24 Jan. 2016.

[71] “Now You Can Watch The Presidential Debate In Virtual Reality.” Fortune, 21 Sept 2016.

[72] Reed, Ryan. “Watch Bjork’s Vivid Virtual Reality ‘Notget’ Video.” Rolling Stone, 25 June 2018.

[73] “Microsoft HoloLens and the NFL Look into the Future of Football.” Windows Central, 2 Feb. 2016.

[74] “Virtual Reality Is for Artists.” Time, 2018.

[75] “Vive Studios Announces First Feature-Length VR Film, 7 Miracles.” VRFocus, 2018.

[76] “PlayStation VR - Over 200 Games and Counting. Feel Them All.” PlayStation, 2018.

[77] Workman, Robert. “Got a PlayStation VR? Here Are Five Games You Shouldn’t Be Without.” Comicbook.com, 6 Nov. 2018.

[78] Hollister, Sean. “The Best VR Games.” CNET, 27 Nov. 2018.

[79] Jacobson, Jeff, and Jim Dray. “Reducing Design Coordination Errors with VR, AR.” Construction Dive, 13 June 2018.

[80] Mallinger, Kyle. “How Augmented Reality Will Innovate BIM Visualization.” Forbes, 17 May 2018.

[81] “How VR Is Changing the Construction Industry.” VR Vision Group, 22 May 2018.

[82] Parkin, Simon. “How VR Is Training the Perfect Soldier.” Wareable, 31 Dec. 2015.

[83] Stuart, S. C., et al. “Need Some Cultural Sensitivity Training? Your AI Guide Can Help.” PCMAG, 11 Oct. 2018.

[84] Robitzski, Dan. “The US Army Is Using Virtual Reality to Train Their Soldiers to Navigate Real Cities.” World Economic Forum, 2018.

[85] Athwal, Nav. “The Rise Of Virtual Reality In Real Estate.” Forbes, 20 June 2017.

[86] “Bring Your Lessons to Life with Expeditions | Google for Education.” Google Expeditions, Google, 2018.

[87] “What Is Yelp’s Monocle Feature?” Yelp, 2018.

[88] Johnson, Khari. “Google Translate’s Camera Now Reads Arabic, Hindi, and 11 Other New Languages.” VentureBeat, 10 Oct. 2018.

[89] Glon, Ronan. “Head-up Displays Bring Fighter-Jet Tech to Your Car in the Name of Safety.” Digital Trends, 14 Nov. 2018.

[90] Lavrinc, Damon. “BMW’s Shapeshifting, Crash-Proof Motorcycle Is the Future Of Two-Wheeled Mobility.” The Drive, 11 Oct. 2016.

[91] “ART4L - Logistics with a Vision.” ART4L - Logistics with a Vision, 2018.

[92] PricewaterhouseCoopers. “For US Manufacturing, Virtual Reality Is for Real.” PwC, 2018.

[93] “How AR and VR Are Transforming Training in Manufacturing.” CE USA, 9 Aug. 2018.

[94] Kapfunde, Muchaneta. “LFW: Lyst Brings Humannequins and AR to Fashion Week.” FashNerd, 18 Sept. 2016.

[95] Arthur, Rachel. “Augmented Reality Is Set To Transform Fashion And Retail.” Forbes, 31 Oct. 2017.

[96] Kasabian. “Kasabian Live 360 Video | VR Music | VR Case Study.” VISUALISE, 2018.

[97] Holden, John. “Start-up Aims to Rock Live Music with Augmented Reality.” The Irish Times, 4 Aug. 2016.

[98] “Björk The Community – Björk Digital.” Björk The Community, 2018.

[99] Döpfner, Mathias. “Mark Zuckerberg Talks about the Future of Facebook, Virtual Reality and Artificial Intelligence.” Business Insider, 28 Feb. 2016.

Authors and Collaborators

Will Lingard

SOFTWARE DEVELOPMENT DIRECTOR

Will has more than 18-years of experience architecting, designing, developing, deploying, and supporting applications.

Johnny Rodriguez

DIRECTOR OF STRATEGIC INNOVATION

Johnny has over 12-years of experience in UX design and development using cutting-edge web technologies.

Jeff Dance

CEO

Jeff brings years of experience to the digital technology space, overseeing hundreds of creative projects.

Darryl Nicholson

FRONT-END DEVELOPER

Darryl brings 10-years of experience in website design and is skilled across programming languages.