

March 2017



# VR and Augmented Reality

## Market Research

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# 1. INTRODUCTION

Augmented reality (AR) technology integrates digital information with the physical environment, live and in real time. Through the addition of graphics, sounds, haptic feedback and/or smell to the natural world as it exists, AR is able to combine real life with a super-imposed image or animation using the camera on a mobile device or a special headgear.

AR technology reached worldwide recognition after the launch of the popular mobile game Pokémon GO, one of the world's [leading gaming app titles](#). AR technology is used across numerous industries such as: healthcare, public safety, gas and oil, tourism, marketing etc. Everyone from tourists to soldiers to someone looking for the closest subway stop is able to benefit from this ability to place computer-generated graphics in ones field of vision.

In contrast to virtual reality (VR), which creates an artificial environment, AR simply makes use of the existing environment by overlaying new information on top of it. In AR, the information about the surrounding real world is made available to the user for information and/or interaction; for example in helmets for construction workers displaying information about the construction site. Worldwide [shipment of smart augmented reality glasses](#) are forecasted to reach around 5.4 million units by 2020. The [global augmented reality market](#) is expected to grow significantly to about 90 billion U.S. dollars by 2020.

Revenue from augmented reality is projected to three times as high as that of VR by 2020. In that same year, [AR hardware device shipments](#) are projected to reach an estimated 64.8 million units—in comparison to 45.6 million VR hardware devices.

Total revenue for virtual reality (VR) and augmented reality (AR) is projected to increase from \$5.2 billion in 2016 to over \$162 billion in 2020, according to the IDC.

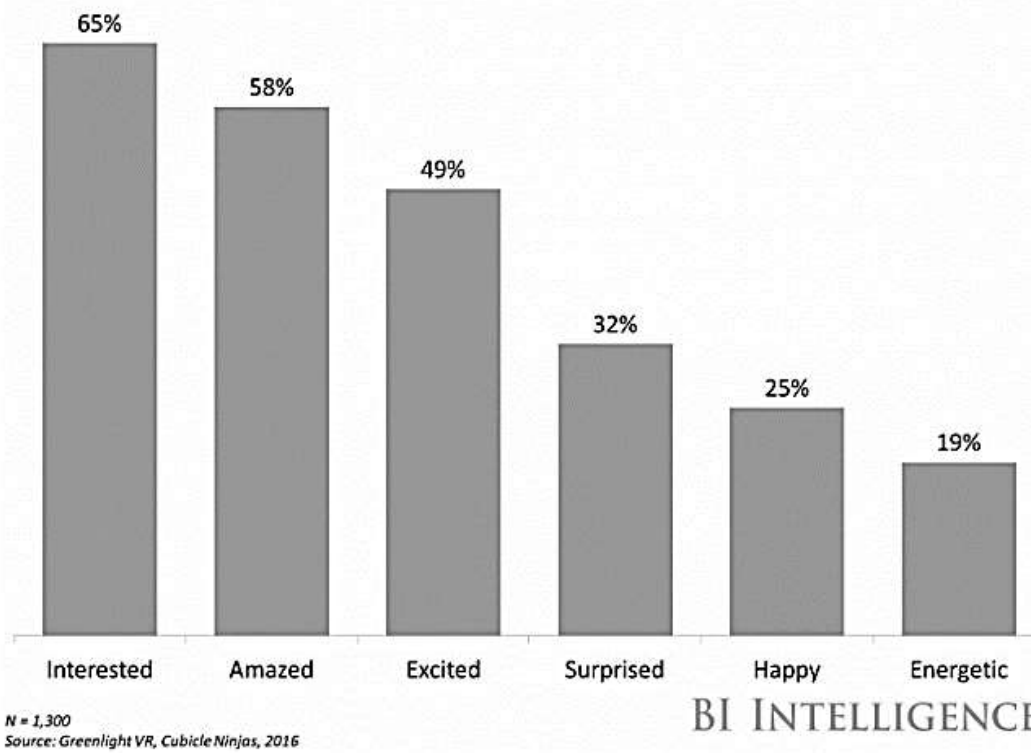
- **More than half of the revenue will come from VR/AR hardware sales.** Additionally, service revenues are projected to increase over the period as demand grows for enterprise-class support. Software was also mentioned as a smaller, but notable revenue source, growing more than 200% year-over-year (YoY) in 2016. Nevertheless, services revenue will quickly surpass it, largely due to demand in the enterprise segment.
- **AR systems will ultimately contribute more revenue than VR systems.** Games and paid content will be strong sources of revenue for VR systems, particularly in the next two years.

However, this revenue will be eclipsed as AR systems are integrated into healthcare, product design and management-related uses.

- **Most revenue through 2020 will come from the US.** The US, Western Europe, and Asia Pacific (excluding Japan) are projected to account for three-quarters of revenue for VR and AR. The US is projected to contribute a larger amount as time progresses.

### How Consumers Feel When Watching Content in VR

(US)



## 2. MARKET ANALYSIS

The adoption of AR and VR headsets will be driven primarily by the introduction of less expensive models to the market, first powered by smartphones before mainstream adoption of stand-alone headsets. While early adopters will drive the initial wave of purchasing, sustainable growth will likely come from VR and AR app developers building a robust and engaging ecosystem of content that entices slower adopters. Lastly, as the underlying technology powering these devices increases, so too will the capabilities, creating new use cases in entertainment, workplaces, and education.

The tech industry has promoted the prospect of VR for the past few decades. But only now, with headsets backed by big names like Sony and Facebook, is VR finally becoming a concrete product

with mass market potential. While VR technology is largely associated with the gaming industry, the platform offers a new set of content opportunities in entertainment, advertising, and more.

### **But where is it all going?**

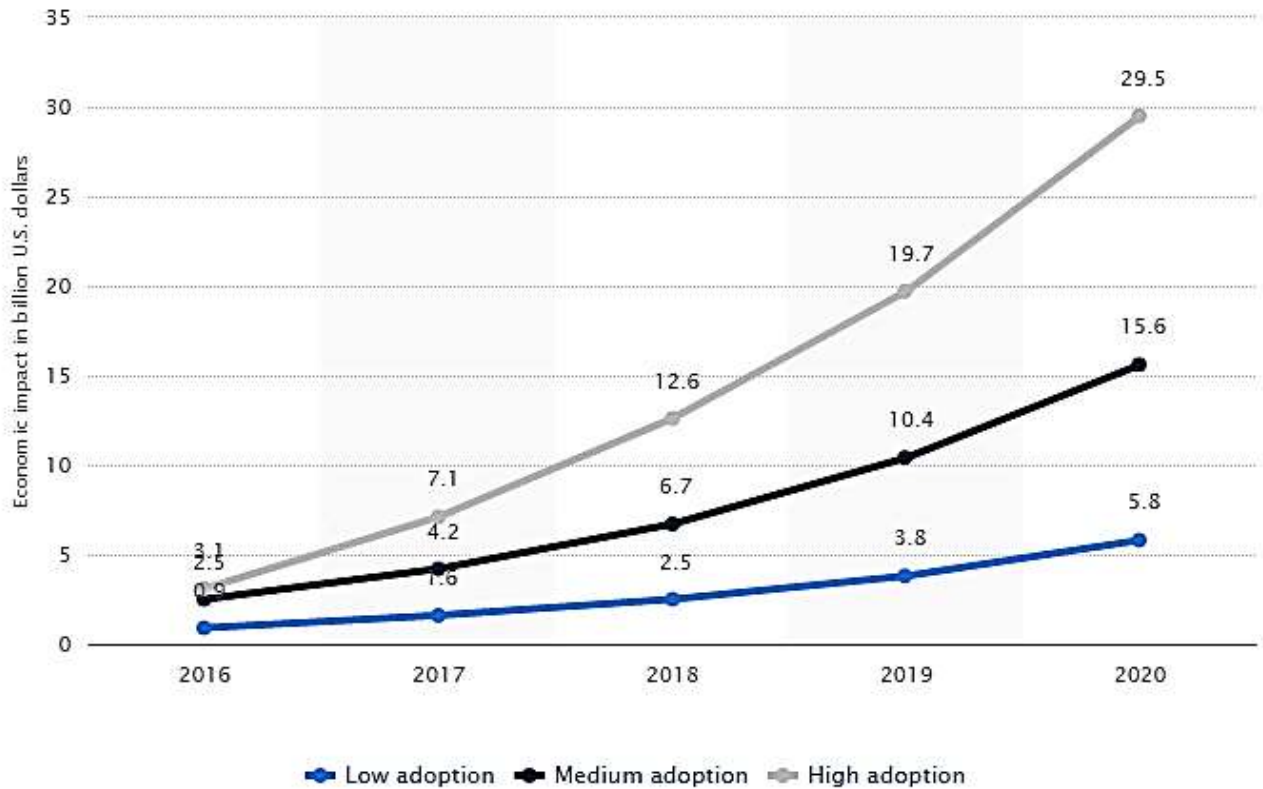
Margaret Boland, research analyst for [BI Intelligence](#), Business Insider's premium research service, has compiled a [detailed report on virtual reality content](#) that examines how various VR headset categories will shape VR content development and looks at the trajectory for mobile gaming revenues to get a sense of how spending on VR content might develop. The report also lays out what types of content users and developers can expect on VR platforms, including gaming, video entertainment, and advertising.

### ***Here are some key takeaways from the report:***

- VR headset manufacturers are driving both the development and distribution of VR content by investing significant technical and monetary resources in developers, in an effort to build up an exclusive content library.
- High demand for VR headsets by mobile and console gamers will fuel demand for VR content. The VR content market will take an increasing portion of the mobile gaming software industry.
- Beyond gaming, VR video entertainment will remain short form until demand for VR headsets increases.
- Ads featured on VR headsets will likely have higher view-through rates than standard video ad spots.
- Other industries are also beginning to experiment with VR content. Travel companies, publishers, e-commerce merchants, and social platforms are beginning to see potential in this new category.
- VR content faces major hurdles that could keep developers from investing: The VR experience must be good enough for people to take up the devices. In addition, developers need to know that a sufficient user base exists to be worthy of the resource investment in VR content.

### **Projected economic impact of virtual and augmented reality technologies worldwide from 2016 to 2020**

The statistic shows three growth scenarios for global economic impact of augmented and virtual reality from 2016 to 2020. In the high-adoption scenario, the economic impact of VR/AR is forecast to amount to 29.5 billion U.S. dollars in 2020.



### Forecast augmented and virtual reality (VR) market revenues worldwide from 2016 to 2021

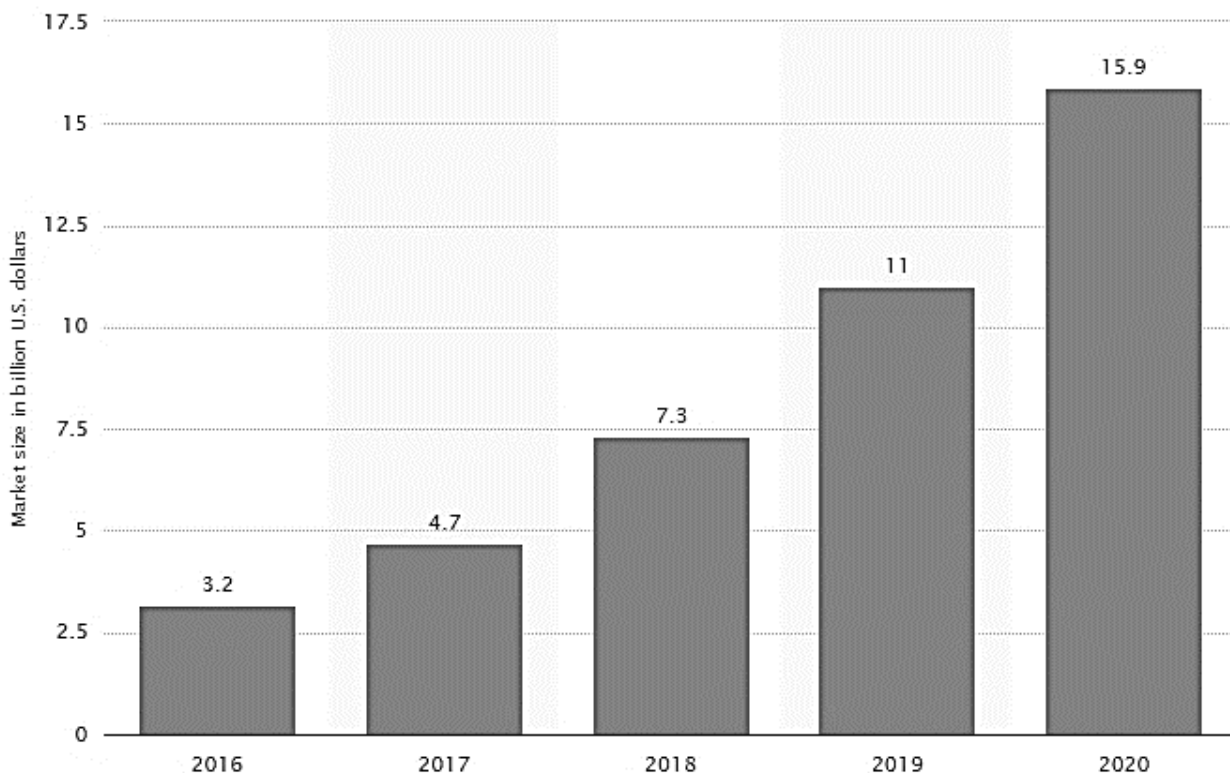
The statistic shows the forecast virtual reality hardware market size worldwide from 2016 to 2020. In 2018, the virtual reality hardware market is estimated to reach a value of 7.3 billion U.S. dollars.

### Virtual reality hardware market – additional information

Virtual reality, which aims at producing an immersive multimedia environment and creating a sensory experience for users, is one of the fastest growing emerging technologies today. Since the technology has been able to offer more novel functionalities in recent years, the market has grown exponentially. By 2018, the total [number of active virtual reality users](#) is expected to reach 171 million. [Revenue generated from virtual reality products](#) worldwide is forecast to reach 5 billion U.S. dollars by that time.

There is a wide array of applications for virtual reality systems, but the majority of commercial activities currently focus on video games. An important device that allows users to immerse in the gaming environment is the head-mounted display – a wraparound hardware which does not allow light or images from the outside to interfere with the virtual images. The hardware market is set to grow at a rapid rate in the upcoming years, to 5 billion U.S. dollars in 2017, including the [sales of](#)

[head-mounted displays](#). [Global VR device shipments](#) are projected to reach more than 6 million units in the same year. Head-mounted displays announced to become commercially available in the near future include the HTC Vive, Project Morpheus and the Oculus Rift.



### **Augmented reality (AR) advertising spending worldwide from 2014 to 2017 (in billion U.S. dollars)**

The timeline shows a forecast of augmented reality advertising spending worldwide from 2014 to 2017. Socintel360 projected that the spending would amount to 12.8 billion U.S. dollars in 2017, up from 0.6 billion in 2014.

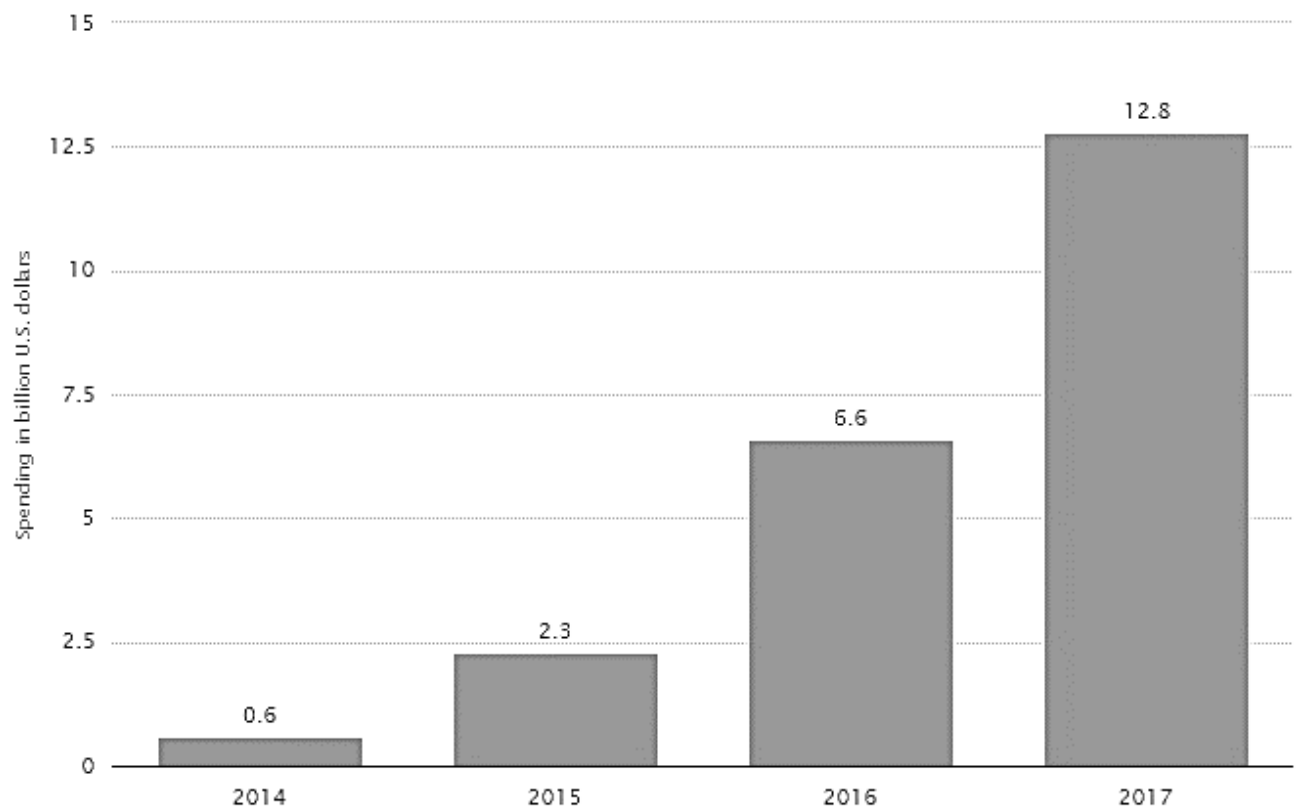
### **Augmented reality advertising spending – additional information**

Augmented reality (AR) is a technology that allows the integration of the physical world with digital information in real time. In other words, computer-generated information is overlaid on top of the real world, creating a modified version of reality. AR aims to blur the line between the real and the virtual world. This technology has several applications, and has already been used in the industrial and medical field. Commercial and entertainment areas, such as art, education, beauty and advertising, have also used augmented reality. This is a promising technology for many industries, as the [AR](#)

[market](#) shows healthy projections for the coming years. The number of AR users is projected to grow from 60 million in 2013 to 200 million by 2018.

Considering specialists affirm a live and memorable experience can drive sales and raise brand awareness, augmented reality is a powerful technology for the advertising industry. Spending on augmented reality advertising is forecast to increase at an aggressive rate in the coming years. In 2014, 600 million U.S. dollars were spent on augmented reality advertising. This figure is forecast to jump to 12.8 billion U.S. dollars by 2017.

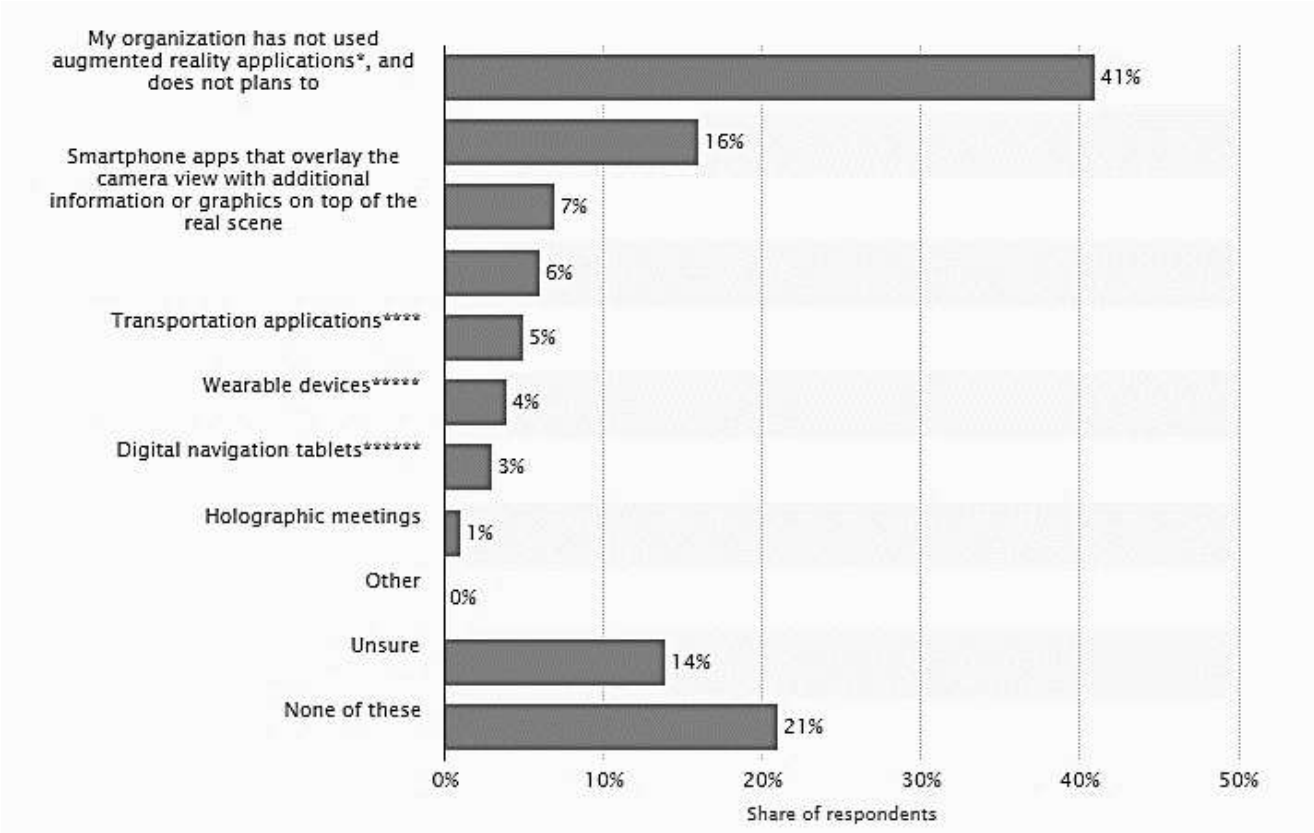
Augmented reality is often confused with [virtual reality \(VR\)](#). The difference between these two upcoming technologies is that augmented reality overlays the physical environment with digital information, whereas virtual reality completely immerses the users in an artificial environment. The VR industry is also growing at a face pace, as [virtual reality products](#) are forecast to generate 5.3 billion U.S. dollars in revenues by 2018. Samsung Gear VR, Oculus Rift and HTC Vive are expected lead the [virtual reality headset market](#); five million units of the Samsung Gear VR are forecast to be sold in 2016, while 3.6 million units of Facebook's Oculus Rift are projected to be sold during the same year.





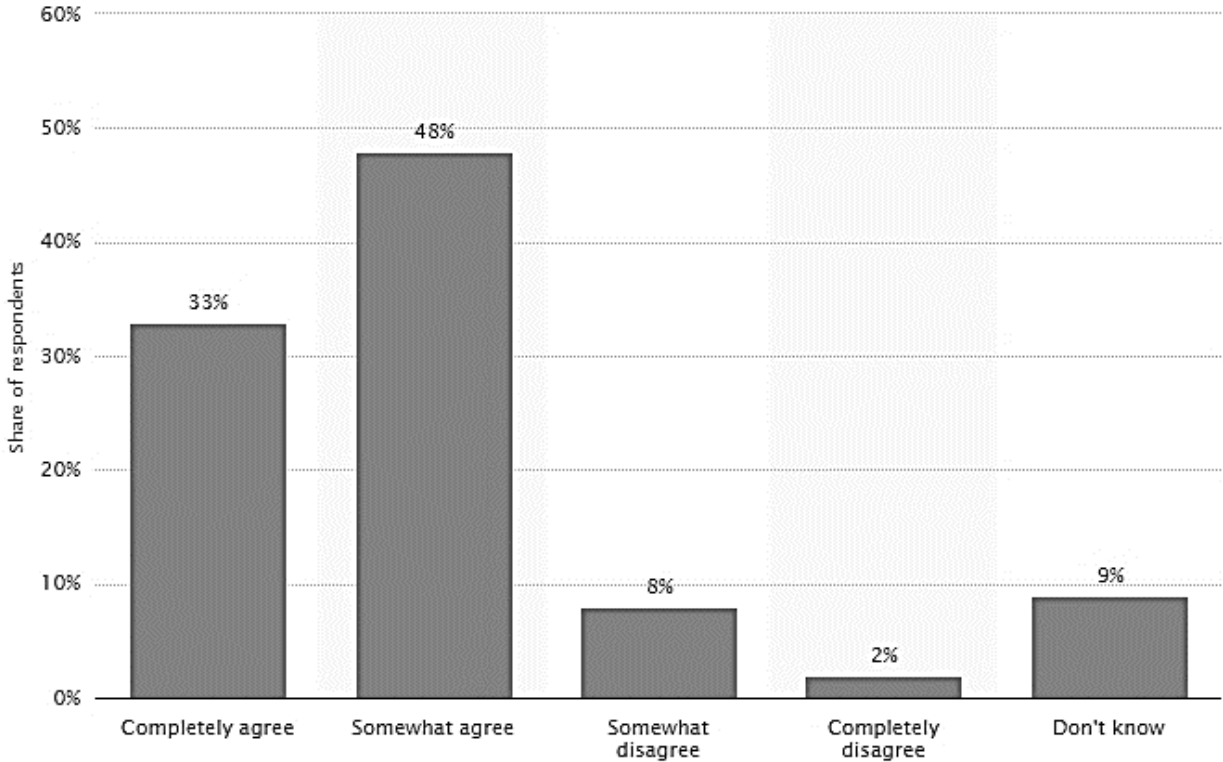
**Which of the following augmented reality applications, if any, has your current workplace used for business purposes in the past year (to the best of your knowledge)?**

This statistic shows the organizations' use of augmented reality applications for business purposes in the United Kingdom (UK) in 2016. The use of augmented reality applications was very low, and nearly half of the organizations did not use them at all.



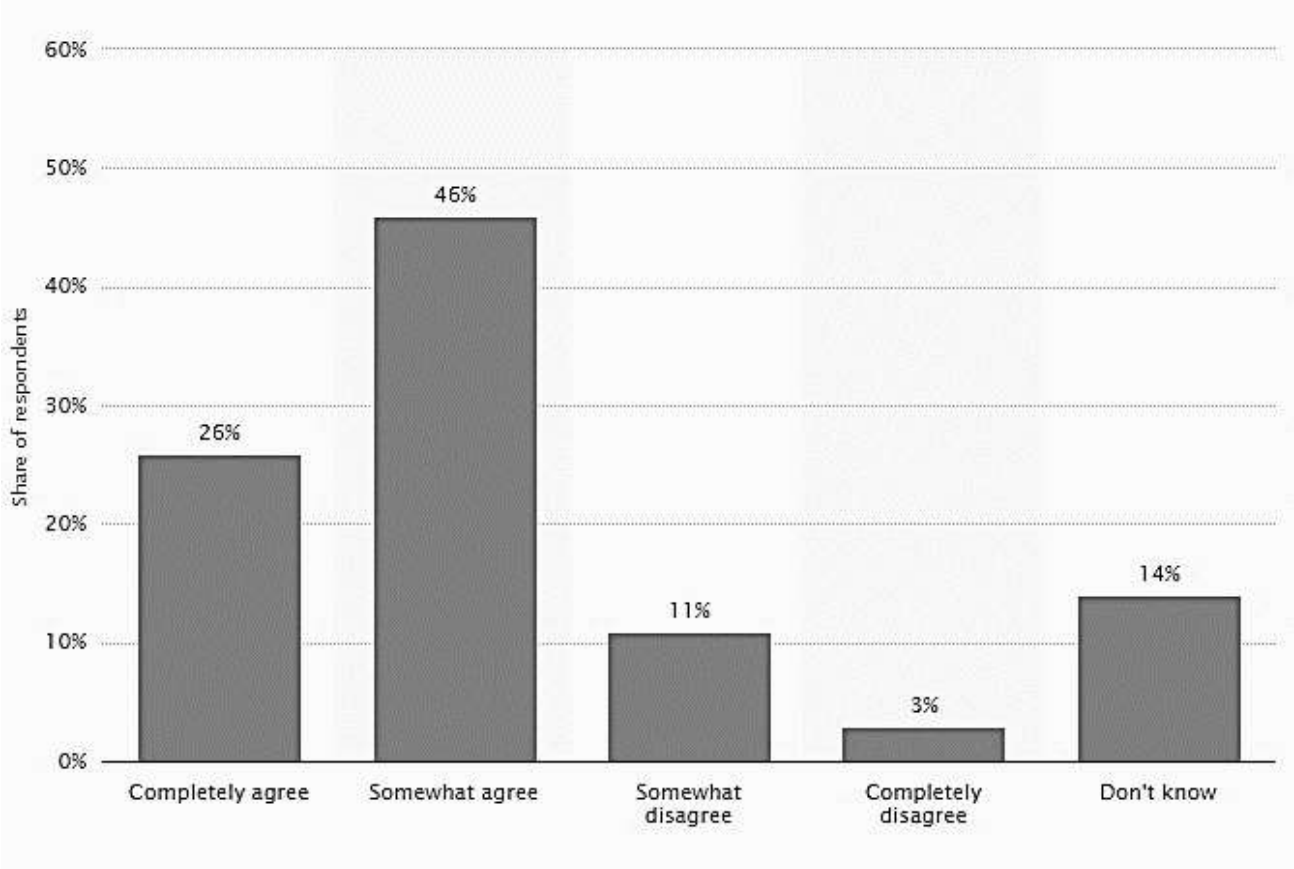
**To what extent do you agree or disagree that augmented reality could lead to the following workplace benefits? -New business models/offerings**

This statistic shows the level of agreement of respondents on whether new business models or offerings can emerge from using augmented reality (AR) at the workplace in Europe in 2016. Almost half of the respondents somewhat agreed on the idea that AR could create new business models.



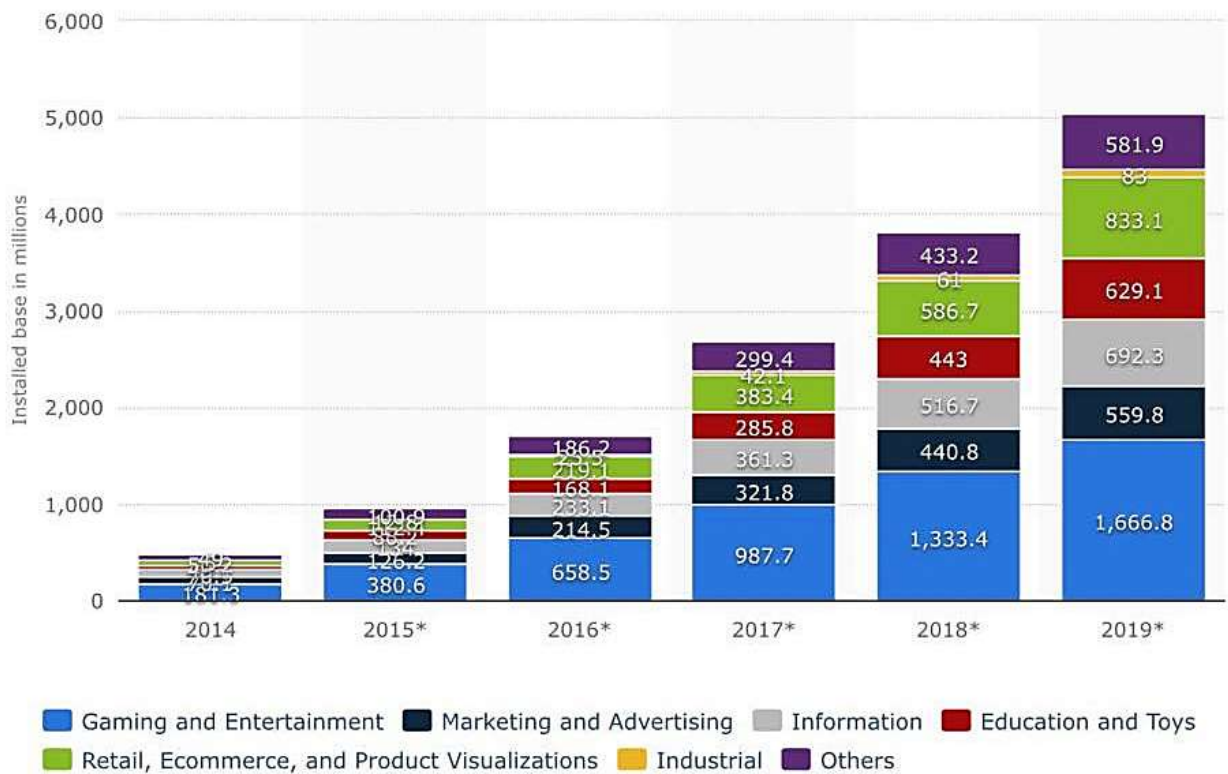
**To what extent do you agree or disagree that augmented reality could lead to the following workplace benefits? - Better marketing**

This statistic shows the level of agreement of respondents on whether better marketing can emerge from using augmented reality (AR) at the workplace in Europe in 2016. The vast majority of the respondents agreed on some level on the idea that AR could create better marketing.



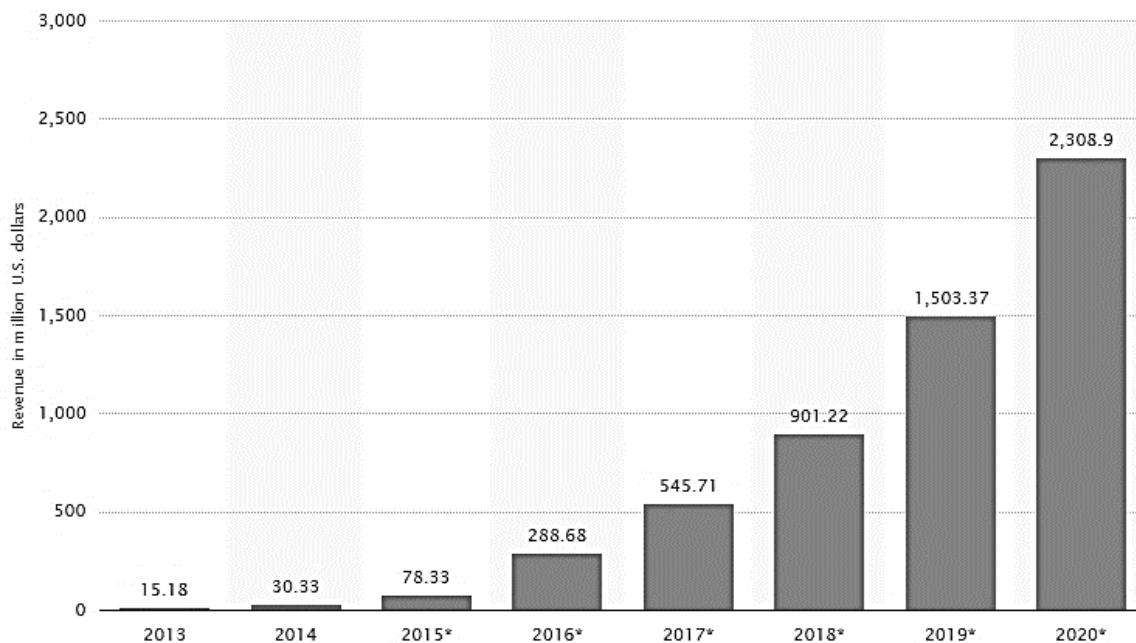
**Installed base of augmented reality applications on mobile devices by type from 2014 to 2019 (in millions)**

The statistic shows the installed base of augmented reality applications on mobile devices, by application type, from 2014 to 2019. The installed base of mobile augmented reality applications is forecast to grow to more than 1.6 billion units in the gaming and entertainment segment by 2019.



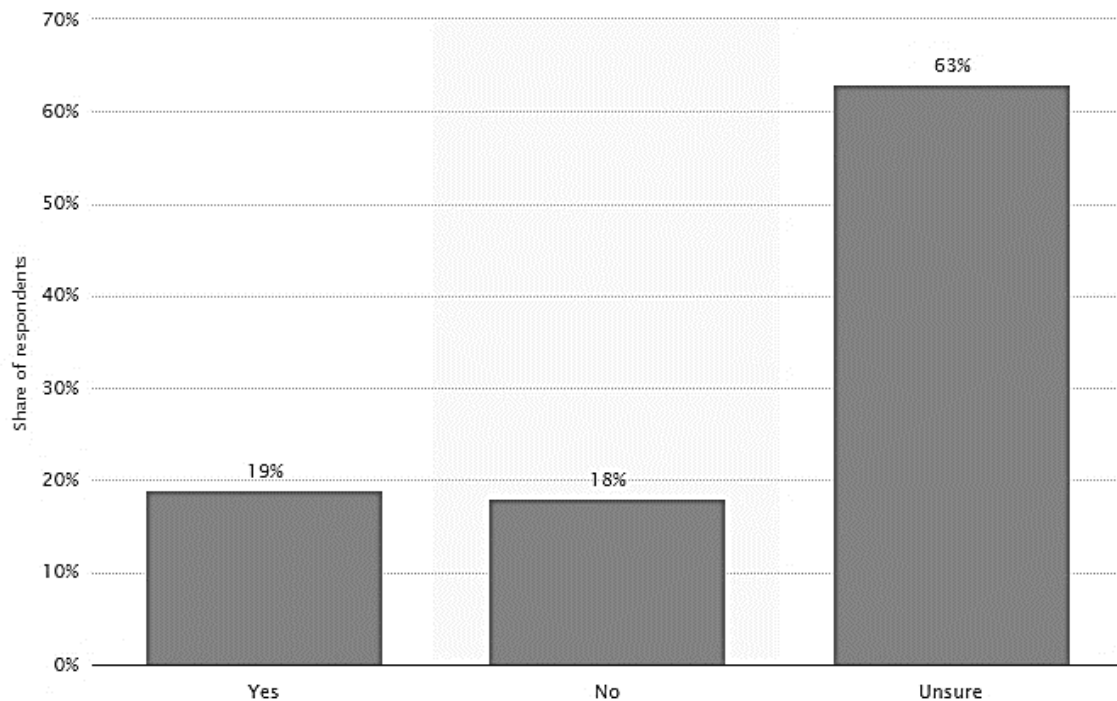
**Smart augmented reality glasses revenue worldwide from 2013 to 2020 (in million U.S. dollars)**

The statistic shows smart AR glasses revenue worldwide from 2013 to 2020. Smart augmented reality glasses revenue is forecast to amount to around 901 million U.S. dollars by 2018.



## Do the benefits of augmented reality outweigh the risks?

This statistic shows the distribution of respondents who believe whether or not the benefits of augmented reality (AR) outweigh the risks in Europe in 2016. The general feeling towards AR was uncertainty. A total of 19 percent of respondents believed that the advantages of AR outweighed its risks.



## Augmented Reality applications in manufacturing

Although AR technologies have been around since the 1990s, the industrial use remains limited and scattered. Most industrial AR applications are at the R&D or piloting stage. It is easy to get media attention if you apply Google Glasses in some corner of your factory, but that does not transform your business. However, with the rapid growth in mobile devices and developments in telecommunications, data storage, and wireless data transfer, AR now stands a much better chance to succeed. My hypothesis:

*In 10 years from now—when the Pokémon generation enters factories for work— we can expect a surge in industrial Augmented Reality applications.*

There are indeed a few companies that have been serious in their AR investments, including Boeing, Airbus, Bosch, and few more. Some good examples are highlighted below. AR can be used for many purposes in manufacturing companies, but its potential is perhaps greatest within these four areas:

- Operations
- Maintenance
- Error prevention
- Training

#### Operations: Boeing tests Google Glass for aircraft wire harness

As a pioneer in AR technologies, we would expect Boeing to be far ahead when it comes to applications. But, also in Boeing it seems that real AR applications are lingering. A Boeing report from 2014 concluded, “AR tracking and display technologies are not sufficiently robust for mainline manufacturing production environments” [4]. One recent reported example from Boeing is the use of Google Glass to assist aircraft wire harnessing [5]. We can imagine the complexity of pulling and connecting all the cables that go into an airplane. Whereas the operator previously looked at a massive PDF document with harnessing schemes at a computer screen, she now has the virtual instructions immediately in sight (Fig. 3). An AR wire harness pilot in Boeing report that the use of Google Glass cut production times by one-fourth and cut error rates by half.

#### **Maintenance: Bosch’ Common Augmented Reality Platform**

Trying to stay at the forefront of AR technology development in the automobile industry, Bosch has been cooperating with AR startup Reflekt since 2013. Bosch offers its Common Augmented Reality Platform (CAP), which can find many applications including maintenance [6]. The technology is an app-based augmented reality not that far away from how Pokémon GO works. It is not hard to imagine how car maintenance can be conducted by anyone with a DIY (do-it-yourself) AR application (Fig. 4). However, also this technology still looks better on PowerPoint presentations and YouTube videos than in reality.

#### **Error Prevention: Airbus’ Smart Augmented Reality Tool (SART)**

Since 2011, Airbus has used AR for several purposes in their manufacturing facilities under the label Smart Augmented Reality Tool (SART) [7]. This tablet technology has many application areas and are used on all aircraft programs today. Almost 1000 Airbus employees use SART every day. One example is from the inspection of bracket installation in fuselage assembly where a tablet with a camera superimposes a virtual image of the as-designed assembly over the actual as-built product (Fig. 5). The AR technology quickly enables the operator to detect any deviation. According to Airbus, the introduction of AR has reduced inspection times in some cases from 3 weeks to 3 days.

## **Training: UNIDOs AR diesel engine maintenance training tool**

When it comes to training operators, both VR and AR technologies have great potential. Virtual Reality is already widely used for training. Typical examples are simulator training for aircraft pilots, military operations, advanced surgery, maritime operations, and so on. In the manufacturing sector, Audi, for example, uses VR to train operators in assembly tasks before doing real shop-floor assembly. AR on the other hand has found far less application so far. There is a lot of talk about the potential benefits, but few systems are in use. One simple classroom example is a solution developed by EON Reality for the United Nations Industrial Development Organization (UNIDO), where students of Volvo Selam Vocational Training Center in Ethiopia learn the basics of diesel engine maintenance (Fig. 6) [8]. Admittedly, this application is really closer to VR than to AR, as it only uses a printed sketch of an engine as reference point in the real world.

## **5 types of AR companies and how they work**

The mobile AR landscape is diverse and can be confusing. While some top Augmented Reality companies provide a range of products, services and publishing options, there are essentially five basic types of **Augmented Reality companies**. The video below serves as primer of the five types.

### **1) AR platform companies**

AR platform companies provide a foundation and the toolbox for experienced software developers working to create advanced Augmented Reality solutions. Some of these companies also build and market their own products, or provide custom services on the side ([Qualcomm® Vuforia™](#), [METAIO's SDK](#), [TotalImmersion](#)). Platform companies enable the other four types of companies and the customer is the experienced developer

### **2) AR product and game companies**

AR product and game companies develop and market their own exclusive AR products such as books or games for consumer retail sale. Some companies use mobile Augmented Reality, but largely they rely on dedicated consoles.

Companies in this space Include [Sphero](#), [POPAR](#), [Sony](#), [Microsoft](#) and [Nintendo](#).

### **3) Self-service DIY AR companies and universal AR viewers**

Designed for quick and simple AR experiences or campaigns, these companies offer content management tools and a limited menu of basic AR effects. With self-service AR tools, tech savvy

individuals can create simple experiences like launching a single video or simple animations. AR self-service companies are great for publishers, educators, students, and others who want to test or create a simple Augmented Reality experience without investing in a complete custom branded app experience. Some DIY companies also offer AR viewers, customized services and white label options. Companies in this space include [Layar](#), [Aurasma](#), DAQRI and Zappar.

#### **4) Custom branded app development companies**

These companies work directly with brand marketers and agencies to build custom Augmented Reality solutions for major advertising campaigns, trade shows and live events. Custom branded apps allow marketers to combine one-of-a-kind custom Augmented Reality experiences with personalized service and project management. Custom features frequently include branding specifications, navigation, user interfaces, animations, complex or large-scale AR effects, and more. Services may include 3D modeling, integration with other software services or ecommerce platforms, game development, location-based installations, notifications, complex animations, micro locations, or other advanced AR effects. Companies in this space include [appshaker](#), GravityJack and [Marxent](#).

#### **5) Industry-specific vertical AR solutions**

The newest category of AR companies to emerge are those offering AR solutions tailored to serve niche business verticals such as luxury retail, medical services, industrial applications, pharmaceutical companies and cosmetic companies. Companies in this space include [Blippar](#) for advertising, [Holition](#) for luxury jewelry retail, [Adornably](#) for furniture placement, and [Marxent's VisualCommerce®](#) for consumer retail, industrial, and enterprise sales tools.

### **What are the top Virtual Reality and Augmented Reality technology trends for 2017?**

2016 was [a breakthrough year for Virtual Reality and Augmented Reality](#). On the VR side, big-name hardware like the Oculus Rift, HTC Vive and Playstation VR all hit the marketplace, bringing with them a flood of content and clever implementations that had early adopters evangelizing about the exciting new technology. On the AR side, the worldwide hit [Pokémon Go brought Augmented Reality into the mainstream](#), setting App Store records in the process. As we enter 2017, the industry is looking to capitalize on this momentum.

So what's in store for Virtual Reality and Augmented Reality in 2017? We asked Marxent's talented team of computer vision experts, 3D artists and engineers to help us suss out what the year ahead will



hold. Here are their predictions for the top **Virtual Reality and Augmented Reality technology trends for 2017**.

### **1. Cut the cord! Wireless Virtual Reality tech to make huge splash in 2017**

Our plugged-in world is about to meet the dustbin of history. You could see the wireless trend emerging in 2016 — the adoption of a [new Bluetooth standard](#), Apple's new [W1 wireless audio chip](#) and earbuds — and the next year will see products across categories ditch the wires in favor of more magical solutions.

In Virtual Reality, this means wireless VR Head Mounted Displays (HMDs). The current generation of hardware has the user connected to a powerful PC via annoying cables. We are excited to be freed from cables in 2017. To the companies that are working on wireless headsets, such as HTC (which has already [partnered with TPCAST to create an add-on](#) that makes the current Vive wireless) and will be the first to market with a fully wireless HMD, we say THANK YOU! Of course, the folks at Oculus, Google, Sony, Apple or Microsoft. In any case, we can't wait for wireless. It is without question the best **Virtual Reality technology trend** that will come to VR in 2017.

### **2. Internet of Things (IOT) will make wireless VR more beautiful – and more dangerous**

Beyond wireless VR, Silicon Valley and major manufacturers are constantly looking for new ways to innovate cords and cables out of the equation. There's already an enormous [Internet of Things](#) (IoT) that allows millions of connected appliances to communicate wirelessly (and sometimes get [hijacked by hackers](#)), and the next year will see programmers find new and exciting ways to leverage all that IOT connectivity.

We'd be remiss if we didn't mention what could be the most important development in wireless for 2017. Word is that [Apple is partnering with a company called Energous on a breakthrough wireless charging solution](#) that will allow the next iteration of the iPhone to charge from across a room. [The tech exists](#), and if Apple really does roll out what Energous has developed, it would instantly create a new product ecosystem around wireless charging.

### **3. AR becomes *the* killer app for smartphones**

Speaking of Apple, there's been a consistent, low rumble of hype saying [the next iPhone will include hardware-level Augmented Reality](#). [Tim Cook has gone on the record](#) to sing the praises of AR, and [Google's Tango platform](#) and the Lenovo Phab 2 smartphone have already shown how such a

system might work. So, is AR going to be the big feature that sells smartphones in 2017? To the few and the fabulous, but it is unlikely to make it's debut in currently popular smartphone lines this year.

Yes, Apple will finally make an Augmented Reality SDK accessible to developers, which should open the doors to more powerful iOS AR apps in 2017. That said, additional hardware like [a depth-sensing camera \(RGB-D, for example\)](#) will be required to create smartphones that include true, hardware-based AR. This tech will likely be available to fanboys of the iPhone, Samsung's Galaxy line, or the Google Pixel in 2018.

That leaves an opening for other manufacturers to use advanced AR features as a way to grab market share. As if on cue, [Asus unveiled the ZenFone AR at this year's CES](#). The ZenPhone comes loaded with Google's Tango technology, and [Asus CEO Jerry Shin touted the handset](#) in the press, saying, "The ZenFone AR will come with advanced functionality and performance at a competitive price." Though it's highly doubtful the ZenFone will displace the iPhone at the top of the smartphone world any time soon, the AR functionality Asus is bringing to market is here to stay, and will be baked in to multiple handsets by year's end.

#### **4. You'll shop in Virtual Reality**

Virtual Reality is about to shake up retail, with the planet's biggest merchants already making moves to take control of this emerging category. Global giant [Alibaba](#), the world's largest retailer, [has launched a VR store called Buy+](#) that allows shoppers to wander a VR mall complete with big name stores like Macy's, Target and Costco. Internet auction giant [eBay teamed with Australian retailer Myer](#) for what was touted as "the world's first VR department store." Meanwhile, retail colossus [Amazon.com](#) may not be far behind, as recent job postings hint at a future VR for Prime shoppers.

Beyond e-commerce, VR is also seeing steady adoption across a host of product categories. There's already a [VR car dealership](#), and [VR for real estate](#) has been gaining traction for a while. 2017 will see [Ashley Furniture](#), the largest furniture manufacturer in the world, [bring VR into its showrooms](#) for the first time. [Ikea is also embracing VR](#) by allowing shoppers to design their dream kitchen — something home improvement giant [Lowe's started working on a few years ago](#). Expect to see VR pop up in many more retail spaces in 2017, as businesses experiment with the best ways to utilize the technology.

## **5. Someone will try to live in VR for a week straight**

The only question is whether it will be done in the name of art or science. No matter the reason, some brave psychonaut will don a VR headset and attempt to set a record for the most amount of time spent in a VR space without taking a break. If the above video features [Derek Westerman](#) enduring 25 hours in an HTC Vive is any indication, the person that eventually breaks the record is in for a dizzying but thrilling experience.

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