

ARTILLY INTELLIGENCE BRIEFING

XR: 2017 LESSONS, 2018 PREDICTIONS

DECEMBER 2017



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Executive Summary

2017 was quite a year for AR & VR (a.k.a. XR). As is often the case with emerging technology, XR's early days have included a fair amount of exuberance. This year kicked off as such, continuing from 2016. But excitement levels began to recede in mid-2017 as several market signals emerged.

Among those signals, we saw the beginnings of a funding crunch as several companies perished after failing to secure follow-on investing rounds. We saw TechCrunch pronounce (falsely we believe) that VR is dead. Many of these activities stemmed from disappointing consumer VR adoption.

This realization caused the XR world in 2017 to shift attention from high-end VR to mobile AR, given its large installed hardware base. Apple's June ARKit unveiling amplified those excitement levels, which then weakened as the platform's September release was met with tepid consumer response.

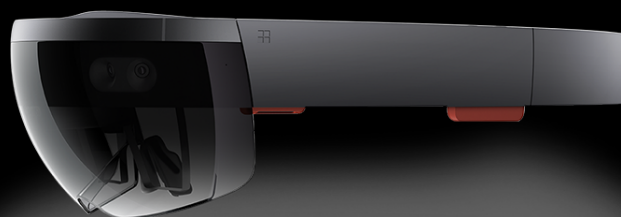
So the question is: Where are we now with AR & VR, and what can we expect in 2018? Drawing from ARtillery's XR coverage and market sizing over the past two years, we have ventured to answer this question. In short, excitement levels haven't been misplaced... but some have been mis-timed.

As a historical comparison, e-commerce was prematurely heralded in the early 2000's dot-com bubble (which ARtillery analysts lived through). The market sizing and exuberance at the time wasn't overblown: In fact it underestimated eventual revenues. It was just early, by about five years.

ARtillery Intelligence believes that has parallels – though a different timeline – to where we now sit with XR. Massive opportunity exists but expectations should be adjusted about its imminent arrival. This realization can help inform go-to-market strategies and operational execution for XR players.

But how and when will it all come together? What are the top factors and trends to examine? What are key drivers for interlocking pieces in the XR universe (AR, VR and enterprise and consumer segments of each)? And what does it all mean for where you sit? This report tackles these questions.

We'll take a look back at 2017 to extract measurable lessons, and predict XR's direction in 2018. It's all about zeroing in on the pockets of greatest opportunity, and -- as always -- timing. Spoiler alert: there will be real revenue and value creation in 2018, but they'll require strategic precision.



Introduction: A Market Correction

In late 2014, one market event jumpstarted a wave of excitement over virtual reality (VR) and by extension, augmented reality (AR). Facebook acquired VR hardware maker Oculus. Now collectively known as XR, the AR and VR segments then built up to peak attention and investment in 2016.

This carried into 2017 before receding a bit as market signals began to indicate softness in consumer hardware adoption.¹ As is often the case with emerging tech, hardware comes first and creates an installed base for software. But VR hardware (headsets) unit sales didn't grow as expected in 2017.

This led to a funding crunch, as a few companies perished after failing – due to adjusted market size estimates -- to secure follow-on investing rounds. TechCrunch boldly but wrongly proclaimed VR's death, followed by several other publications -- the same publications that previously hyped VR.

All of this caused attention to shift to mobile AR, given its larger installed hardware base of 500 million smartphones in 2017. Apple's June ARkit unveiling then amplified those excitement levels. But even that fizzled to some degree, as its September release was met with tepid consumer response.

Altogether, this shifting market sentiment and investing activity can be seen as a correction to the attention and investment levels that defined 2015 and 2016. But it doesn't mean that VR or AR are dead, as headlines indicate. It only means that their potential will take longer to materialize.



¹ See ARtillery Article, May 25, 2017: *Is a VR Shakeout Coming?*

Silver Lining

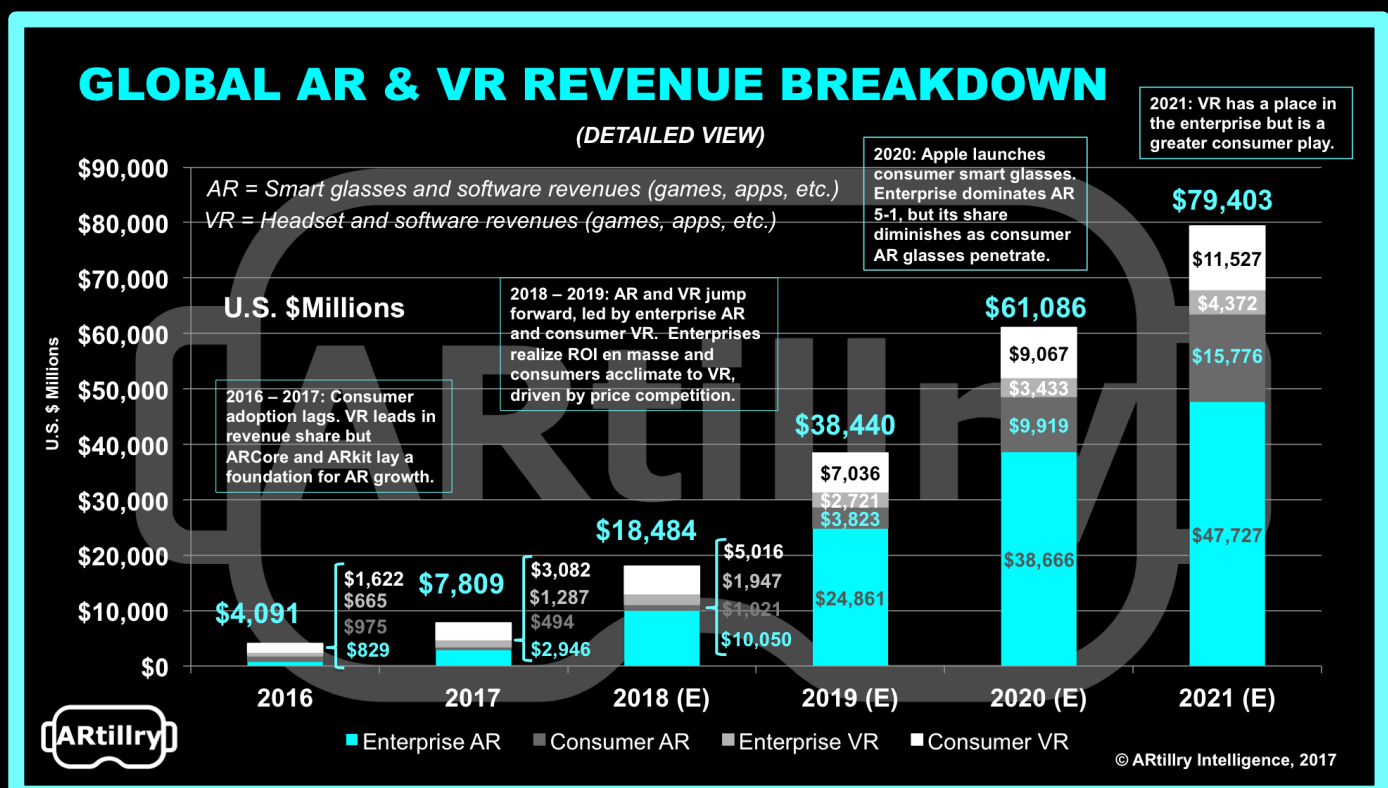
There are many signals and marketplace evidence -- examined deeper in the coming pages -- to back up the previous statement. The short version: We're seeing ROI proof points for enterprise AR (manufacturing efficiencies), and revenue model validation for consumer AR (mobile AR apps).

As for VR, its potential will take a bit longer, but a few signals give us confidence for upcoming 2018 & 2019 milestones. Among them, Sony announced in December that it has reached 2 million PlayStation VR units sold, a strong growth indicator. And Oculus unveiled the standalone Oculus Go.

The latter will prove to be a key inflection point for consumer VR when the device launches in mid-2018. Not only does it have a user-friendly price (\$199) that aligns with ARtillery's consumer sentiment data (explored later), but it's built on dedicated hardware for frictionless plug & play functionality.

There's also strength in location based VR, especially in China where cultural affinities for out of home gaming experiences will be an important revenue opportunity to cover the gap before VR home ownership becomes more ubiquitous. We saw the same trend with video games in the 70's and 80's.

2017 also saw lots of activity in XR's underlying technologies. A top area of funding, these "building blocks" include things like haptics, inputs, processing and graphics libraries. The activity and investment around these technologies are a positive leading indicator for XR's longer-term growth.





Speaking of funding, XR collectively received \$2.1 billion in venture funding in 2017 according to Crunchbase. This is equivalent to 2016, meaning that tempered attitudes haven't reduced funding levels. Moreover, funding levels are growing quarter over quarter with Q4 2017 funding of \$80 billion.

Investors' confidence signals² include the fact that some forms of AR & VR are built on established foundations of the smartphone ecosystem, including hardware and distribution (app stores). AR & VR also have broad global applicability (consumer and enterprise) and strong backing from tech giants.

"When was the last time you saw a technology where you have Google, Facebook, Apple, Microsoft, Samsung, and Sony beating each others' brains out," Comcast Ventures' Michael Yang told ARtillery on stage during an event late last year. "If they're focused on this, it's going to go somewhere."

Lastly, aligned with many of these signals, ARtillery's latest XR market sizing paints a mostly positive picture and "cautiously optimistic," long-term view. Shown above, it projects total XR revenue – including AR, VR and enterprise and consumer segments of each – to reach \$79 billion by 2021.³

These and other signals, events and trends are examined in the following sections. Together they indicate strengths, weaknesses -- and most of all timing -- for AR and VR's market growth. These sub-sectors of XR are ruled by different dynamics so we'll tackle them one by one.

Video Companion: XR's Road to \$80 Billion

(click URL to open)

<https://youtu.be/pLLLZyvFD2k>



² See ARtillery Intelligence Briefing: *Smart Money: Insights from AR & VR Investors*.

³ See ARtillery Intelligence Briefing: *Global AR & VR Revenue Forecast 2016-2021*



VR: Formidable But Delayed

Starting with VR, its slower than expected consumer adoption has been a source of skepticism towards the XR industry. These demand levels will pick up as prices fall and content libraries grow, but it could take a few years more than initially expected. Meanwhile, there are signs of opportunity.

“It’s Different This Time”

Slow consumer VR adoption has prompted critics and skeptics to point to previous decades’ VR “waves”, which each crashed and receded. These include periods of the 80s and 90s. But despite historical precedent, and VR’s current softness, *ARtillery Intelligence* believes this wave is different.

This outlook has been informed by industry veterans such as Unity VR/AR lead Tony Parisi. When he started working in VR in 1993, infrastructure included desktop machines with megahertz processing and 3d graphics with 20-30 frames per second, run through large manually-inserted graphics cards.

“That has changed radically in the past 20 years,” he said during June’s AWE conference. “We have supercomputing powers in our pockets, we have fast networks, we have all kinds of infrastructure on the web to push the content, and deliver apps. We had none of that back then.”

The other major difference today is the market’s collective 3D animation prowess, he says. The current VR wave emerges at a time when there’s ample 3D animation capability. This enables a content layer to sit on top of — and further fuel investment in — the aforementioned infrastructure.

“We now have millions of people who can create 3d content, thanks to what’s happening in gaming, visual effects and design software,” said Parisi. “We have kids coming out of school and we have ten year-old kids using modeling packages.”

Last but not least, it’s about the audience. The “digital natives” that now comprise a vast majority of the media consumption public will be increasingly receptive to, if not salivating for, immersive content. And that hunger and savvy will only amplify as the upcoming Generation Z gains purchasing power.

“We have a whole generation of people now who expect this,” said Parisi. “They’ve grown up on video games, they’ve grown up on CG movies. They expect fully interactive and mobile content.”

Quantifying VR

The factors Parisi outlines are key considerations for VR’s market outlook, but they only go so far. There’s an additional layer of quantitative metrics required. They include unit economics, recurring revenue, consumer acquisition cost, lifetime value, and total addressable market (TAM).



TAM is a particularly important metric, and in XR's early days it's a function of hardware sales. With consumer VR specifically, hardware sales (headsets) have been slower than expected. The industry's excitement levels – though cooling recently – haven't been proportionate to aggregate sales.

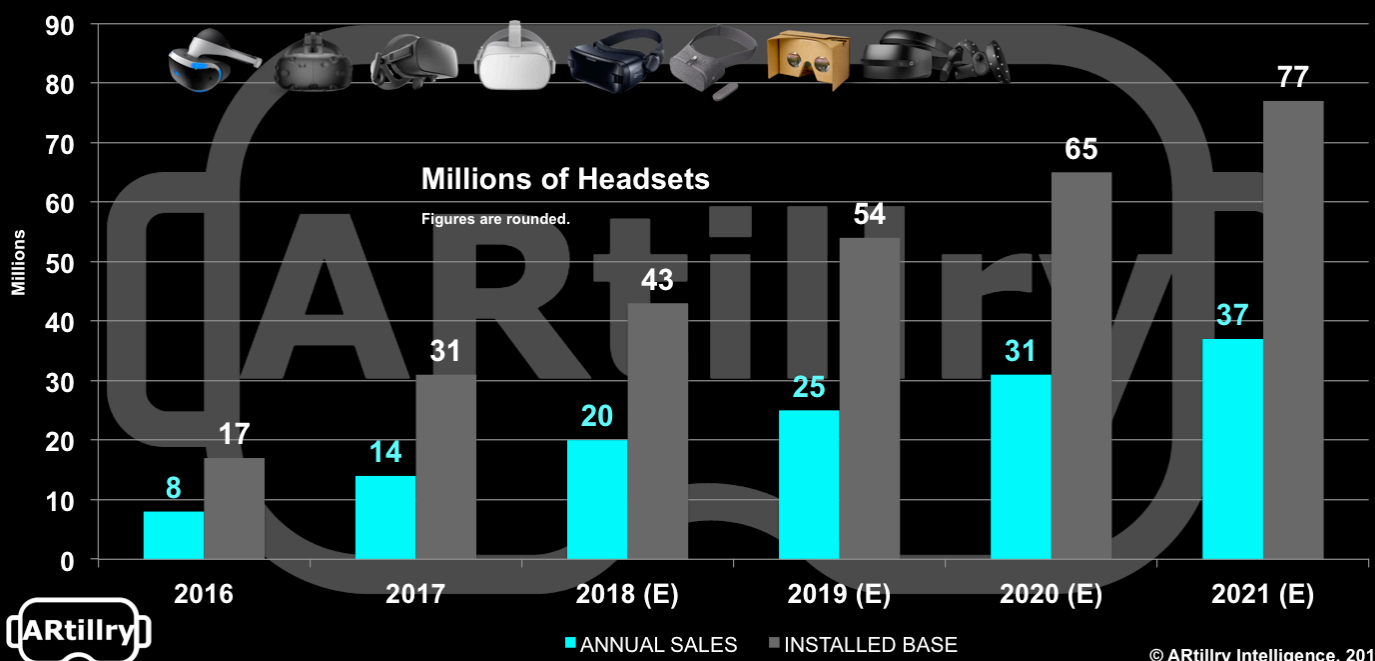
And this exacerbates one of VR's biggest challenges for users and developers: fragmentation. An already-finite user base is divided into smaller pieces when there are competing platforms that aren't always interoperable. Unifying tech, such as web VR, will be a trend to watch in 2018 and beyond.

The Magic Number

Meanwhile, ARtillery has done the math which indicates that there are roughly 31 million headsets sold so far globally at all device tiers (including cardboard). To put that into perspective, the current ubiquitous tech product – smartphones – have reached a global installed base of 3.2 billion units.

This indicates that VR headsets have a long way to go. And the magic number is 100 million units. That's the size of the installed base that will be a key milestone and turning point for VR. It's the number that attracts content creators and supporting functions, as well as a network effect.

GLOBAL VR HEADSET INSTALLED BASE





This is precisely what we saw with smartphones. Once 100 million units were sold globally, the mobile industry accelerated and could support an app economy and several other moving parts. This is due to the larger incentive for content creators and supporting tech vendors to enter.

This happens through a sort of snowball effect. The gravitational pull of 100 million units attracts new entrants who accelerate the industry's advancement and output. That further boosts unit sales, which in turn attract more entrants. So the march to 200 million or one billion units comes even faster.

ARtillery Intelligence has projected that the installed base of VR headsets will reach roughly 77 million by 2021. Based on these projections, it won't reach that 100 million mark until the early to mid 2020s. This installed base projection factors in current sales, growth trajectory and historical comparisons.

VR and AR industry leaders have likewise begun to look at this 100 million-unit milestone as a key target. Most notable is Unity CEO John Riccitiello, who carries an admittedly cautious outlook for VR hardware penetration... and its current distance from the 100 million mark.

"If there isn't at least a near term probability of 100 million devices in the marketplace that can play it, [developers] won't build," he asserted at VRLA last Spring. "A hundred million devices creates an umbrella for the entire industry to flourish and I think we're a few years away from that."

Price Sensitivity

So what will it take to drive VR adoption closer to 100 million units, and to reach the growth rates *ARtillery Intelligence* has projected above? There are several factors that drive consumer sentiment, including content availability and price, as examined in ARtillery's August Intelligence Briefing.⁴

Price is particularly impactful, as VR's waning excitement levels aren't enough to outweigh price sensitivity for products that exceed \$1000. Because higher-end VR experiences (Tier 1 and 2) require a PC, mobile device or console, it pushes the "all-in" price beyond that threshold.

The price where consumer interest spikes according to *ARtillery Intelligence* consumer research is \$400, and more so at \$200 (see chart below). This gives us confidence in VR's emerging category of standalone headsets, which don't require additional hardware for processing and battery life.

Nowhere is standalone VR better represented so far than the specs and features of the forthcoming Oculus Go. Though we won't get to see it in action until mid-2018, many of its announced attributes have theoretical advantages for mainstream appeal, including its \$199 price tag.

At this price, the headset is giftable (think: holidays 2018). It could bring mid-tier VR to a greater swath of the mainstream public, and better seed VR marketplaces. In other words, a larger VR installed base will incentivize developers to build games and apps, thus boosting VR content libraries.

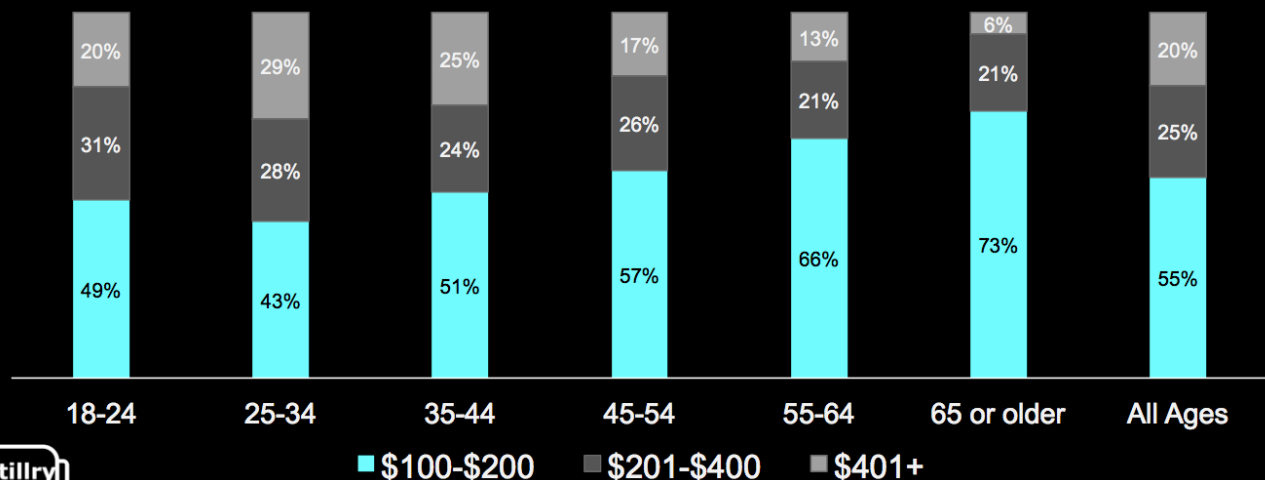
⁴ See ARtillery Intelligence Briefing: *VR Consumer Usage & Attitudes*



The standalone category also includes devices that will be built on Google's Daydream platform. This will include Google's WorldSense inside-out tracking system, three degrees of freedom (3DOF) headsets and a hand controller. Lenovo is currently developing such a headset as is HTC.

VR PRICE SENSITIVITY (BY AGE)

WHAT IS THE MOST YOU WOULD PAY FOR A VR HEADSET / SYSTEM?



■ \$100-\$200 ■ \$201-\$400 ■ \$401+

Source: ARtillery, Thrive Analytics

Loss-Leader Economics

With its pricing strategy, Oculus could end up doing the VR industry a favor in terms of accelerating growth. This stems from the fact that Oculus has the luxury (Facebook backing) of treating VR hardware as a loss leader to build market share and establish a longer-term platform strategy.

Platform wars are often won through momentum set in early days to attract users by any means (including price). Then there's a domino effect of developer interest, content creation, and more users – a virtuous cycle. Oculus will play this long game, thereby boosting VR adoption through discounting.

ARtillery believes we'll see continued price competition in 2018, which will jumpstart that cycle. It will take a while for the wheels to turn and for robust content libraries to develop. But things will begin to move more meaningfully in 2018, starting with accelerated adoption from the \$199 Oculus Go.

Collateral Damage

Oculus Go could also be detrimental to competing VR hardware manufacturers. Companies like HTC and Samsung have business models that are reliant on hardware margins and therefore can't discount as heavily. HTC has already aborted standalone headset plans in the U.S. for this reason.

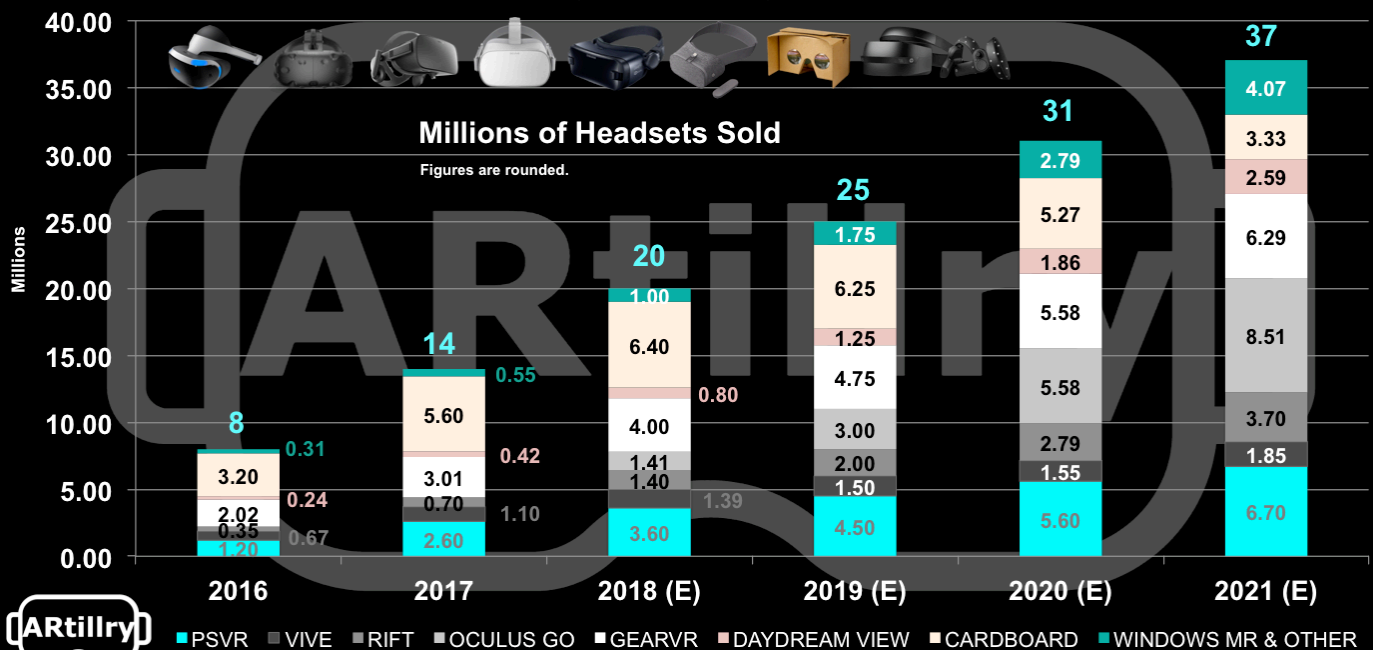
And though most of the above pertains so far to standalone VR headsets, such as Oculus Go, the looming question is if these competitive dynamics will move up market to Tier-1 VR: Given that Oculus has been aggressive with Rift pricing, could it impact HTC's flagship Vive in the same ways?

One takeaway for VR developers is to keep an eye on pricing and adoption. Not only will that inform market sizing and revenue projections, but also platform decisions. Given Oculus' market share gains from discounting, it could create a greater installed base for game and app developers to reach.

Overall, it's a lesson in loss-leader economics, and in the strategic positioning in early days of platform wars. We saw the same with the smartphone OS wars (iOS vs. Android). And just like that period, consumers benefit most. Prices will continue to drop, along with an arms race for VR quality.

GLOBAL VR HEADSET UNIT SALES

(DETAILED VIEW)



© ARtillery Intelligence, 2017

Unwired

Beyond price, functionality is an important factor when examining the potential impact of standalone VR like Oculus Go. The consumer appeal lies not just in lower price but also less wires and dedicated hardware. It's tuned for VR, rather than sharing functionality with a phone, as mobile VR does.

This comes down to friction, which has stood beside price as a VR adoption factor. For example, Oculus Go will have plug-and-play functionality as opposed to mobile VR's sometimes-disjointed experience. That includes firmware updates and other smartphone quirks that get in the way of VR.

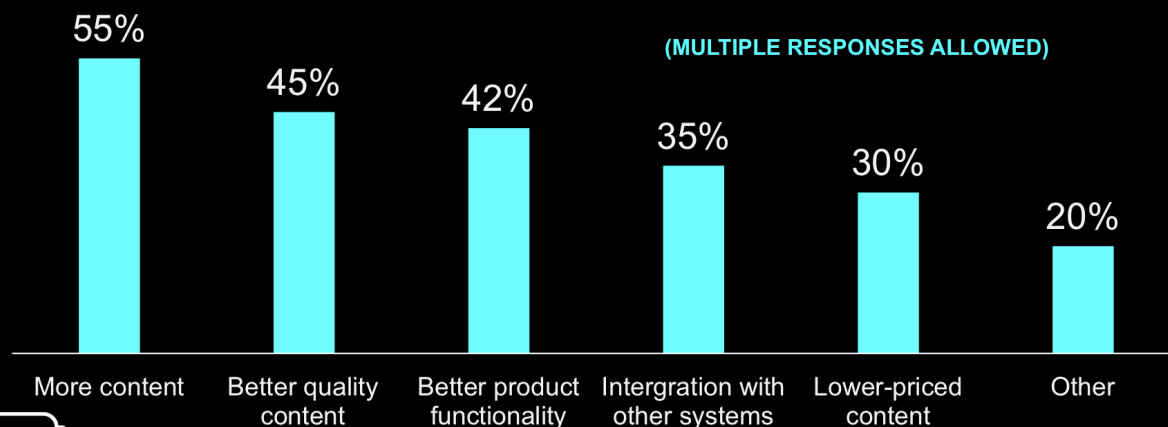
"It's the same software, but [without] the trouble of starting it up, docking it, launching an application, and getting through that," Oculus CTO John Carmack recently said. "The standalone that can sit there as a device that's just ready when you put it on: That is a significant change in experience."

A dedicated hardware approach could alleviate VR adoption barriers, including this user friction problem that Carmack references. Beyond mobile VR, friction also afflicts higher-end VR systems like Oculus Rift, considering things like PC startup time, wires and setting up external tracking hardware.

"Friction matters a lot," added Carmack. "I preach this in all sorts of application areas where one click versus two clicks versus three clicks make enormous differences. People that are hyper analytic about website conversion rates know the value of a lot of these things."

VR AREAS OF IMPROVEMENT

IN WHAT AREAS WOULD YOU LIKE TO SEE IMPROVEMENTS FOR YOUR CURRENT DEVICE?



Source: ARtillery, Thrive Analytics

First Impression Matters

Along with standalone VR advantages like dedicated hardware and price, there are disadvantages. If standalone VR is to be an icebreaker for mainstream VR adoption, some argue that it's not the best representation of VR. Like mobile VR, it lacks features like optimal graphics and low latency.

Some VR industry voices argue that compromised VR experiences do the industry a disservice by giving a sub-par first impression to mainstream consumers. As it often goes with first impressions, this can have a lasting effect on the collective mindset towards VR's quality level and true value.

NVIDIA's Martina Sourada expressed a similar devil's advocate position on standalone VR at a recent VR/AR Association panel discussion that ARtillery moderated. She argued that the best of both worlds — untethered, while also high quality — will only be realized when Oculus' Santa Cruz arrives.

For those unfamiliar, Santa Cruz is Oculus' headset that it hopes to release to developers in 2018. It will contain all of the high-end feature specs of the Oculus Rift but in an untethered form. That includes inside-out (built-in) positional tracking as well as portable CPU and GPU processing.

Meanwhile, standalone VR could have the price tag and simplicity to at least bring mid-tier VR to a larger consumer audience. Even if it's not an ideal representation of VR's potential, it could advance the industry and counteract some of the skepticism it's received in 2017 for being too niche.

Video Companion: Consumer VR Sentiments

(click URL to open)

<https://youtu.be/411xNjwJADU>





AR: The Larger Market

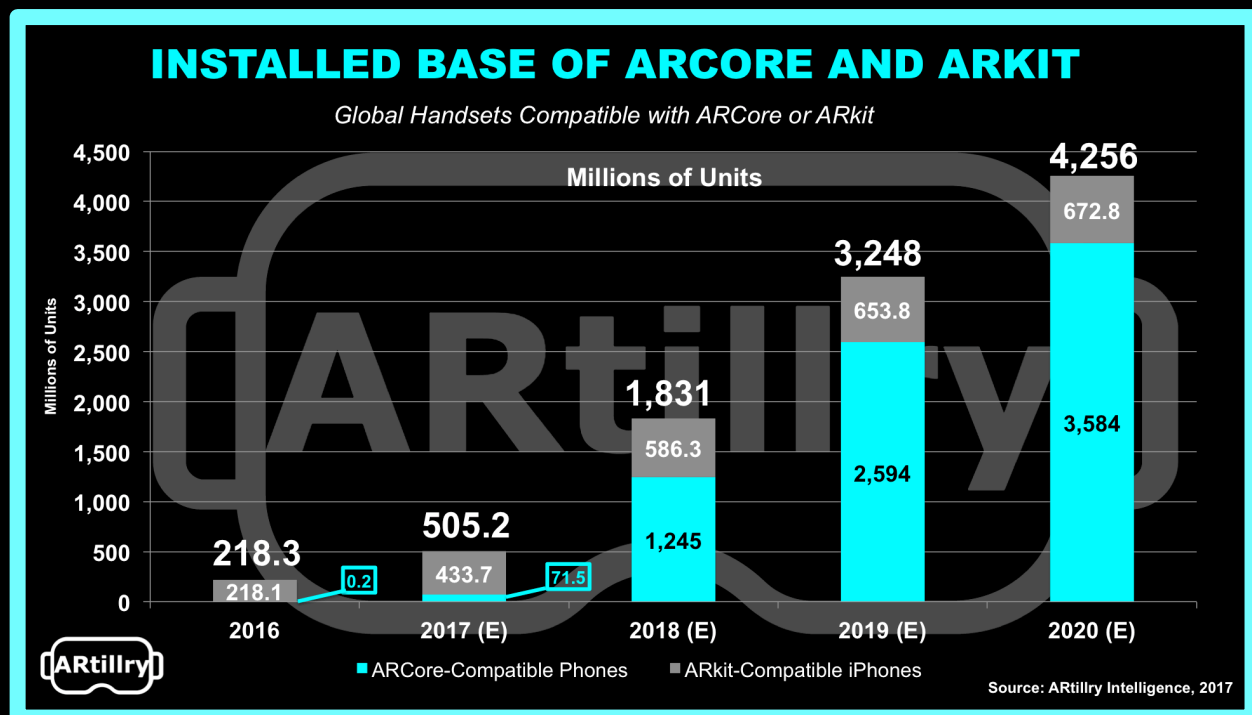
The realization of disappointing consumer VR adoption has caused XR investors, entrepreneurs and the tech media to shift focus to AR. That includes sub-sectors of AR that hold nearer-term opportunity and scale, including consumer AR (smartphone-based) and enterprise AR (glasses-based).

Mobile AR: Strength in Numbers

VR's relatively low installed base quantified above is contrasted by mobile AR's sizeable global installed base. Given that mobile AR apps operate on existing smartphones, they have greater capacity for scale. This addresses one of the key metrics introduced above: TAM

More specifically, mobile AR builds on the foundation of existing global smartphone penetration. That total market today is 3.2 billion units, while the smaller subset of AR-compatible smartphones is about a half-billion today, growing to 4.2 billion units by 2020, according to *ARtillery Intelligence* projections.⁵

Beyond sheer scale, mobile AR's opportunity was accelerated in 2017 by Apple's ARKit and Google's ARCore. Both standardize underlying AR functionality and significantly lower barriers for app developers. Developers can focus instead on user experience and business models.



⁵ See ARtillery Intelligence Briefing: *ARCore & ARKit: The Acceleration of Mobile AR*



Where's the Money?

What are those business models? Many will develop over time as consumer usage patterns evolve and inform revenue-generating tactics. Meanwhile, there are already signals that indicate where business models can develop. These build on established app store dynamics and usage behavior.

For example, in anything gaming-related (a big mobile AR category), it's been proven that in-app purchases are often more strategic than upfront app purchases. With utilities such as mapping and navigation (likewise fitting to AR), transactional or ad support for local discovery could be strategic.

One well-established app has many of the above properties: Pokémon Go. Its revenue model is mostly in-app purchases. Similar impulse-driven revenue from competitive game mechanics could drive AR revenue, as well as Snapchat-esque social activity like sharing (paid) stickers and graphics.

Another factor that Pokémon Go revealed is the viability of location based promotions and sponsorships. That so far includes cost-per-action advertising for visits to McDonalds in Japan. ARtillery believes this will continue to evolve and gain share in Pokémon Go's revenue mix.

Beyond Pokémon, we'll see revenue models that tap into mobile AR's capacity for location-based discovery. This has natural ties to promotions that are highly trackable, such as local commerce (i.e. store visits). This is one reason why Snapchat acquired location analytics company Placed.

To frame the opportunity, consumer AR revenues were \$975 million in 2016, growing to 15.8 billion by 2021 according to ARtillery's latest forecast (chart below).⁶ This mostly includes software (apps and games) until 2020 when revenue shifts towards hardware, such as Apple's rumored smart glasses.

'AR-First' and 'AR-Only'

For success in any of the above revenue models, compelling mobile AR user experiences first have to be developed. And one of the biggest guiding principles to achieve that goal is to apply native thinking. Build new experiences around AR capability, rather than tacking AR on to existing apps.

Also known as "AR-first," we learned the same lesson in "mobile first" app design strategies of the last decade. Extending that logic, "AR-only" thinking also holds potential. This involves AR experiences that can't exist outside of AR: It should be critical to an app's functionality, not just additive.

Furniture or car visualization apps are good examples of AR-only thinking: They solve real pain points — personalizing large items — and are only possible in AR. Non-AR Only thinking is conversely represented by games whose AR mode is only slightly additive to the experience.

⁶ See ARtillery Intelligence Briefing: *Global AR & VR Revenue Forecast 2016-2021*



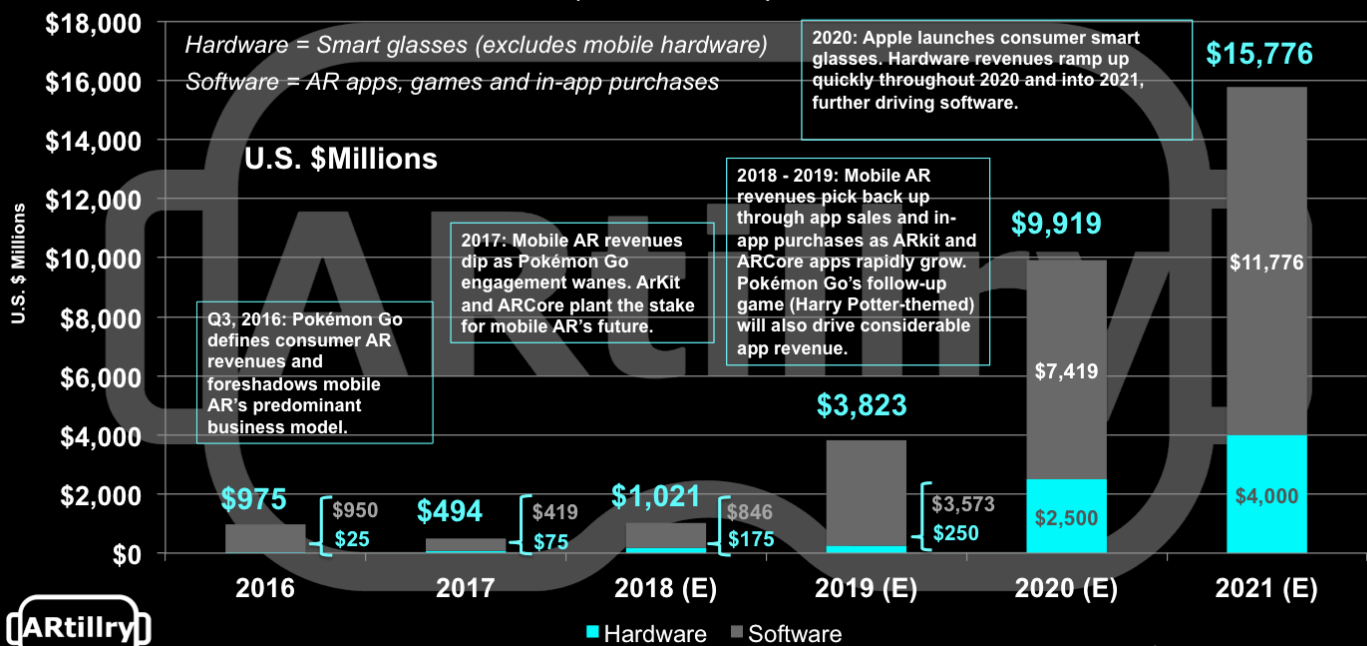
At early stages of AR there will be a lot of this “add-on” functionality. But we’ll eventually get to the true AR value when the first breakout AR-only app catches fire. It was that same thinking that brought us apps like Uber, which at the time of inception was “mobile-only”... it wouldn’t work on PCs.

Part of the challenge comes down to a classic “Silicon Valley effect.” Being immersed in a tech culture, it’s hard to detach and put ourselves in the shoes of mainstream consumers. But the challenge is to solve human problems and pain points, rather than engineering feats.

“What are other problems where AR finally helps bridge the gap?” Samsung Next’s Jacob Lowenstein posed recently at AWE Europe. “Work backwards from there. Because if you’re going technology-first you’re going to end up walking into a door.”

CONSUMER AR: HARDWARE VS. SOFTWARE

(DETAILED VIEW)





Repeat Performance

Beyond native thinking it's important to be mindful of novel thinking, and to not rely too greatly on it. There are lots of low-value AR apps already populating Apple's app store, which have value that resides only in novelty. The problem is that novelty wears off quickly and those apps languish.

This can be avoided in a few ways, many of which inherit best practices from the last decade in app development. For example, game mechanics that balance challenging play with attainable goals tend to perform well. Achievement-based rewards and social sharing can also cause stickiness.

Tools that engender ongoing utility can also prove more sustainable, such as anything that is grounded in a frequent activity like communications. Combining some of the above factors, AR apps that infuse or add value to communications and social interaction can have greater active use.

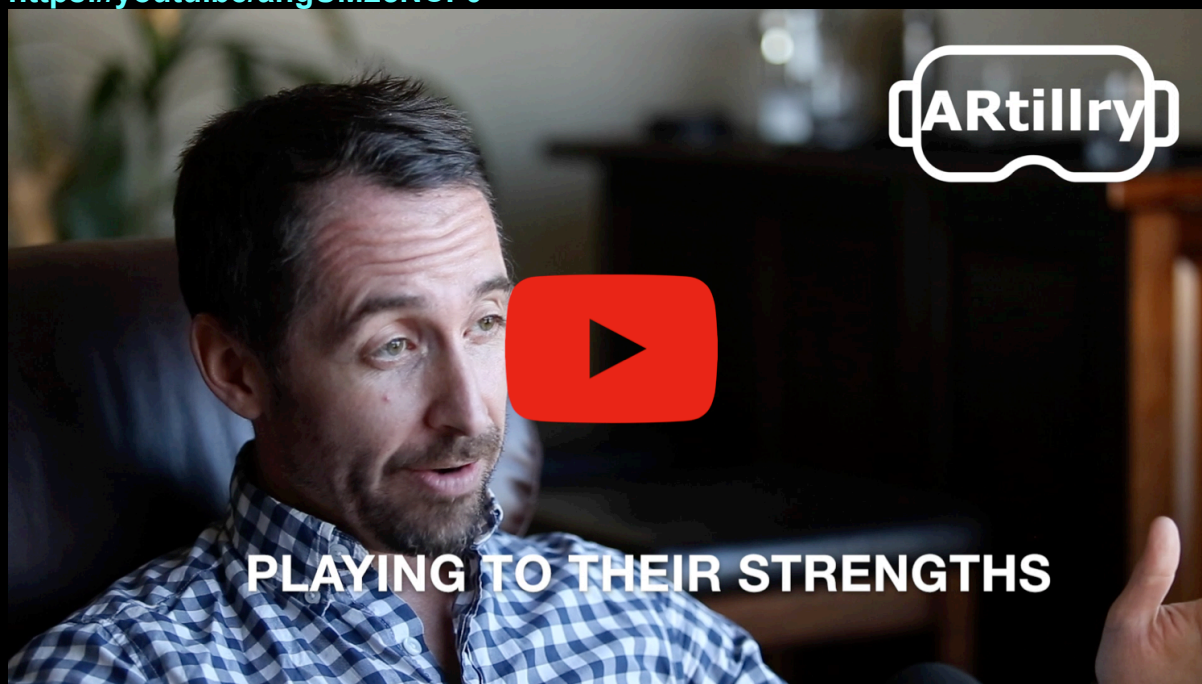
One example of that combination is Israel-based Snaappy. It develops AR animated characters that add dimension and meaning to social messaging. This not only carries the above traits but it does so on top of an increasingly-popular and frequently-used interface for millennials: messaging.

"Communication is good when it comes to retention but bad when it comes to wow effect and engagement," Snaappy CEO Gal Shvebish told ARtillery. "On the other hand, AR is great for wow effect and engagement, but bad when it comes to retention. If you combine the two into one system, you can take advantage of both [and] really create something that will be here for the long run."

Video Companion: Unpacking ARCore & ARKit

(click URL to open)

<https://youtu.be/angUM2cNCF0>





Enterprise AR: Go Where the Money Is

In the above examination of consumer AR, you may have noticed that the focus was on mobile with little mention of smart glasses. Apple's AR glasses could launch in 2020, but until then glasses aren't sleek enough for consumer markets. But in the enterprise (fewer stylistic needs) that's not the case.

Enterprise AR will benefit from a strong ROI case, including measurable operational efficiencies and error reduction in manufacturing and assembly. AR glasses will also be widely applicable across enterprise verticals and designed for all day use, given pass-through vision (versus VR's isolation).

All of these factors have influenced ARtillery's outlook on enterprise VR. In fact it's the XR sub-sector where we project the fastest growth and largest eventual market size. Specifically, *ARtillery Intelligence* projects enterprise AR to grow from \$829 million to \$48 billion by 2021 (chart below).

Why such steep growth? First, from a market sizing and forecasting perspective, there are often high growth rates associated with sectors that start from such a small base. Enterprise AR's current revenue levels are early stage, and will see high growth rates if the sector is to reach its potential.

That eventual market size is partly driven by enterprise AR's inherent ability to scale. That scale stems from its composition of both hardware and software. The latter is key: As we've seen in historic comps and benchmarks like enterprise SaaS, it can have highly scalable and recurring revenue.

Hardware will dominate enterprise AR revenue in early years, as an installed base is established (as is often the first step for new tech adoption). That hardware base will pave the way for enterprise software implementations, which will slowly gain share of enterprise AR revenues in outer years.

The Nearer Term

As for nearer-term lessons (2017) and outlook (2018), there are already signals in today's enterprise AR execution that indicate best and worst practices. For example, it's advisable for enterprise AR players (and VR for that matter) to have deep knowledge of the verticals they're selling into.

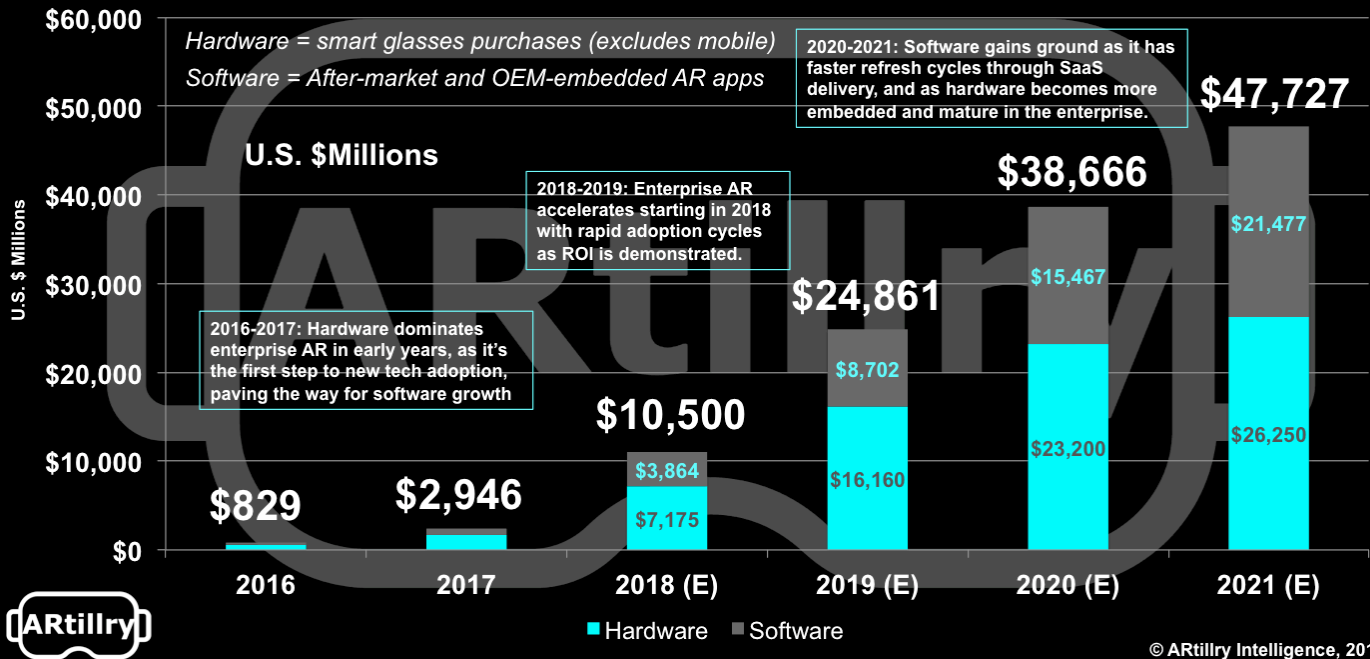
This enables perspective of the pain points that XR technologies are meant to solve. Conversely a technology-first approach (per Lowenstein's comments earlier) can be a "solution in search of a problem," and fail to gain enterprise acceptance. This can come down to personal background.

"For a general-purpose developer, trying to understand a vertical is harder," Comcast Ventures' Michael Yang told ARtillery late last year. "I'm looking for people from oil and gas, or aerospace or construction who envision AR overlays that make processes more efficient and intelligent."

The lesson this tells us: The most successful enterprise XR integrations in 2018 will come from companies with cross-disciplinary perspectives. Startups should assemble teams accordingly, including a mix of technological talent, business development, and enterprise domain expertise.

ENTERPRISE AR: HARDWARE VS. SOFTWARE

(DETAILED VIEW)



Show and Tell

Yang also advises enterprise-focused XR players to know the dynamics of enterprise software buying cycles. Some XR players may not realize yet that they're software companies and therefore must learn the rules of the game in order to compete. In other words, it requires "speaking the language."

"To really understand how to create a software solution for them, you have to understand their underlying business process," he said. "If you haven't spent time with enterprise software developers or systems integrators, you're not understanding the business problem you're trying to apply VR to."

Lastly, it's all about ROI and bottom line impact. One of the signature benefits of enterprise AR is a strong ROI story for enterprise buyers, as stated above. But that ROI story will only resonate if it can be quantified. So 2018 will be all about demonstrating ROI through case studies and data.

"Driving change isn't easy," said Coca-Cola Director of Product Management Michael Terrell at AWE Europe. "But we always have to go back to the data and let it prove or disprove what we're thinking. And in this case, the data is showing me that this technology is truly impacting my bottom line."



Boiling it Down: Lessons & Predictions

2017 Lessons

1. Market Correction: Weaker than expected AR & VR (XR) hardware sales defined 2017. As is often the case with emerging tech, hardware is a key leading indicator because it comes first and creates an installed base for software and overall market growth. VR hardware's softness in 2017 led to restrained industry excitement levels, readjusted market sizing and a funding crunch. Attention shifted to mobile AR, given its greater installed hardware base, but even that has receded to some degree as it's gotten a slow start with consumer demand and compelling content. This all amounts to one big market correction from the XR exuberance that defined 2015 and 2016.

2. Silver Lining: It's not all bad news for XR. The sector's early exuberance wasn't misplaced but was mistimed. Like ecommerce in the early 2000's, its eventual market size exceeded expectations... but not until 3-5 years later. It's therefore better to view XR today as a period of early-stage R&D than one that's ready for prime time (especially VR). On that measure, there are positive signs for XR's long-term health including investment levels in "building block" technologies. Meanwhile other signals provide confidence: \$2.1 billion in 2017 XR funding (equivalent to 2016) and strong early sales – though weaker than expected – for VR hardware such as PSVR's cumulative two-million unit sales. There's also strength in location based VR, especially in China where cultural affinities for out of home gaming experiences will be an important revenue opportunity to cover the gap before VR home ownership becomes more ubiquitous. We saw the same trend with video games in the 70's and 80's.

3. TAM Right: Weak VR hardware adoption caused the market to shift focus towards mobile AR's larger installed base. There are 3.2 billion global smartphones, 500 million of which are AR compatible given the "democratization" of AR brought by ARKit and (soon by) ARCore. ARKit received a slow start for consumer demand and compelling content, indicating that it will take more time for mobile AR's promise to be realized. Like VR's "chicken and egg," dilemma, it will take time before mobile AR apps compel larger audiences and vice versa (though it will happen faster than VR). Meanwhile, meaningful download and usage levels for mobile AR didn't happen in 2017 and will need more time to develop, along with mobile AR business models. Mobile AR revenue in 2017 was roughly \$500 million, mostly from Pokemon Go, which stands as a model for mobile AR business models (in-app purchases). Best practices for AR app design are starting to emerge, including "native thinking" "AR-first" design, and achieving stickiness for recurring usage. Meanwhile, we've seen mostly misfires and no "killer app" that defines the category yet.

4. Augmenting Jobs: Enterprise AR joined mobile AR as a nearer-term opportunity in 2017. Unlike slow adoption for consumer VR, enterprise AR and VR have a clearer ROI story and receptive buyer.



This includes measurable bottom line impact from operational efficiencies through AR-guided manufacturing and assembly (speed, error reduction, etc.). In 2017, we began to see ROI proof points through pilots and case studies. Best practices have also begun to develop with respect to selling XR integrations into enterprises and navigating famously-cumbersome sales cycles for large organizations. These best practices include “speaking the language” of enterprise software sales. They also include building teams that have strong cross-disciplinary orientation such as technical chops, business development and vertical domain expertise for target markets.

5. Optimizing VR: Weak consumer VR adoption has created a greater impetus to define user demand and preferences. *ARtillery Intelligence* consumer sentiment data in 2017 revealed that the top adoption factor for consumers is content. However, content is held back by a classic chicken and egg dilemma where a low installed base dampens content creation and vice versa. This will alleviate over time as falling hardware prices boost VR adoption. Speaking of price, it's the second biggest consumer adoption factor. According to *ARtillery Intelligence*, the price target where consumer interest in VR spikes the most is \$200. This brings VR to a giftable range and one that can appeal to a much greater swath of the consumer public. This is where the newest batch of “standalone,” VR headsets could have real impact, including the \$199 oculus Go announced in 2017 for mid-2018 launch.

Video Companion: XR's 2017 Lessons

(click URL to open)

<https://youtu.be/8Z5UAmWJnrl>





2018 Predictions

1. Enterprise AR Pulls Ahead: Enterprise AR will pull ahead of Consumer VR as the leading XR sub-sector (consumer VR held that leading position in 2017), reaching revenue of \$10 billion. The biggest adopters in 2018 will be manufacturing and assembly, which have the clearest ROI potential for enterprise AR. The biggest challenge will be organizational red tape and sales cycles. So the name of the game will be quantifying ROI, demonstrating bottom line impact and having domain knowledge in enterprise verticals (in addition to immersive tech competency). Those who can hit those marks will be most successful in tapping into enterprise AR's \$48 billion opportunity by 2021.

2. Mobile AR Rebounds: After surging in 2016 due to Pokémon Go, then dipping in 2017, mobile AR revenues will rebound in 2018, exceeding \$1 billion. This will mostly come from app revenue, including Niantic's Harry Potter game that inherits Pokémon Go's architecture and game mechanics. The predominant mobile AR business model in 2018 will follow Pokémon Go's established model of in-app purchases. We'll also begin to see experimentation with ad support or sponsorship that are tied to location-based discovery and commerce (i.e. retail store visits, navigation, product info).

3. Mobile AR Standards Develop: After disappointing mobile AR app libraries in 2017 (in both quantity and quality), 2018 will continue to see many misfires and unsuccessful apps. A small minority will break out and begin to define the category and seed user demand. They will apply native thinking, "AR-first or "AR-Only" approaches, but these success stories will be very limited in quantity – likely fewer than ten. At least one of these apps will break out in 2018 as mobile AR's first truly native and category-defining "killer app," and will be location-based gaming, social, or commerce oriented.

4. Consumer VR Gets a Jolt: Oculus Go will launch in Q2 2018 and fuel consumer adoption more so than any other single headset to date. Its sales will exceed one million units in 2018, and begin to climb to a leading headset market share in later years. With a \$199 price tag, and more room for discounting, this will jumpstart VR's sluggish sales and adoption rates. It will also create a greater installed base to motivate developers and content creators to build content, thus attracting *more* users to VR in a sort of virtuous cycle. This process will take more than one year to play out, but will accelerate in 2018 to the tune of about 20 million total headsets sold (including cardboard and low-cost units throughout China); and a cumulative installed base of about 43 million headsets globally.

5. Unifying Technologies Emerge: Beyond slower-than-expected consumer VR adoption, the sector has further suffered from fragmentation. The already small user base is divided into smaller subsets when you consider the different platforms and walled gardens (HTC, Oculus, Daydream, etc.). This makes it harder for developers to justify ROI in investing in content because an already-small addressable market gets smaller. Alleviating this challenge will be a major industry priority in 2018, including interoperability across platforms, more low-barrier and cross-platform development tools like Google Blocks and Poly; and unifying technologies such as WebVR and WebAR. Google will take the lead on – and benefit most from – web-based delivery of AR and VR experiences. The AR cloud will develop and gain importance as a repository of geo-tagged data and content to enable and populate AR apps and games. It will be a critical component, given AR's understated need to access mapping and positional data to overlay graphics properly.



Video Companion: XR's 2018 Predictions

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About ARtillery Intelligence

ARtillery is a publication and intelligence firm that examines augmented reality (AR) and virtual reality (VR). Through writings, data and multimedia, it provides deep and analytical views into the industry's biggest players and opportunities. It's about insights, not cheerleading.

Run by career analyst and journalist Mike Boland, coverage is grounded in a disciplined and journalistic approach. It also maintains a business angle: Though fun and games permeate VR and AR (especially the former) long-term cultural, technological and financial implications are primary.

Learn more at <https://artilry.co/about>





About Intelligence Briefings

ARtillery Intelligence Briefings are monthly installments of VR/AR data and analysis. They synthesize original and third-party data to reveal opportunities and dynamics of VR and AR sectors. In addition to data, a layer of insights is applied to translate market events and raw figures into prescriptive advice.

More information, past reports and editorial calendar can be seen at:

<https://artillery.co/artillery-intelligence/>

About the Author

Mike Boland was one of Silicon Valley's first tech reporters of the Internet age, as a staff reporter for *Forbes* (print) starting in 2000. He has been an industry analyst covering mobile and social media since 2005, and is now Chief Analyst of *ARtillery Intelligence*, covering emerging tech.

Mike is a frequent speaker at industry conferences such as VRLA, ad:tech and LeadsCon. He has authored in-depth reports and market-sizing forecasts on the changing tech & media landscape. He contributes regularly to highly read online news sources such as *TechCrunch*, *Business Insider* and the *Huffington Post*.

A trusted source for tech journalists, his comments have appeared in A-list publications, including *The New Yorker*, *The Wall Street Journal* and *The New York Times*.

Further background, history and credentials can be found at:

<http://www.mikebo.land/>





Methodology

This report highlights *ARtillery Intelligence* viewpoints, gathered from its daily in-depth coverage of the XR sector. To support the narrative, data are cited throughout the report. These include *ARtillery Intelligence* original data, as well as that of third parties. Data sources are attributed in each case.

For any market sizing and forecasting, *ARtillery Intelligence* follows disciplined best practices, developed and reinforced through its principles' 15 years in research and intelligence in the tech sector. This includes the past two years covering AR & VR as a main focus.

More about ARtillery's market-sizing credentials can be found here:

<http://www.mikebo.land/forecasting>

Disclosure and Ethics Policy

ARtillery has no financial stake in the companies mentioned in this report, nor was it commissioned to produce it. With respect to market sizing, ARtillery remains independent of players and practitioners in the sectors it covers. It doesn't perform paid services or consulting for such companies, thus mitigating bias — real or perceived — in market sizing and industry revenue projections.

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Questions and requests for deeper analysis can be submitted at:

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