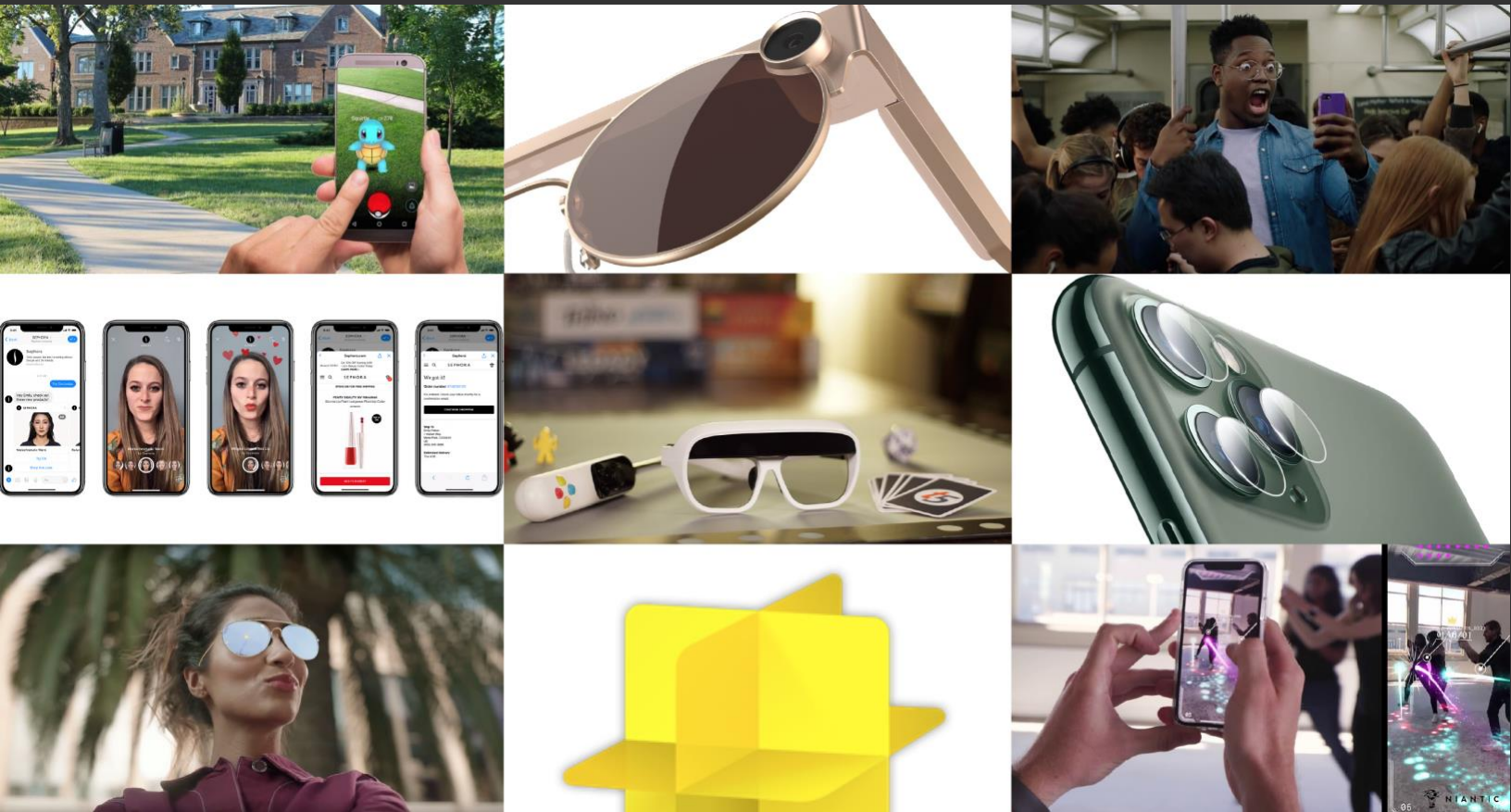# ARtillery Intelligence

ARtillery Intelligence Briefing

Lessons from AR Leaders, Part III: The Field

March 2020

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▐▌ Key Takeaways

▐▌**AR** During consumer AR's early stages, success stories are scarce but critical for extractable lessons.
▐▌**AR** This includes product models (UX design) and business models (when/how/whom to charge).
▐▌**AR** Though enterprise/industrial AR is important, this analysis focuses on consumer-based AR.
▐▌**AR** Together with Parts I & II of this report series, several patterns and transferrable lessons are evident.
▐▌**AR** Consumer AR success factors will be a moving target but are starting to standardize into best practices.

▐▌**AR** After examining revenue leaders in Parts I & II, we'll turn attention to promising emerging players.
▐▌**AR** This includes AR *converts*, *enablers* and *hopefuls*, segmenting the market into a few key areas.
▐▌**AR** AR *Converts* are established companies that are now moving into AR, such as Instagram.
▐▌**AR** AR *Enablers* are the "picks & shovels" tool providers who are accelerating AR's advancement.
▐▌**AR** AR *Hopefuls* are players to only recently enter the market, worth watching for their early demand signals.

▐▌**AR** Starting with AR *converts*, deep-pocketed companies entering AR are advantaged by resources & networks.
▐▌**AR** However, these factors don't guarantee success which relies on execution and following best practices.
▐▌**AR** Among AR converts – Instagram, Houzz and Pinterest – one common thread is AR's point of integration.
▐▌**AR** Each of these players has integrated AR in ways that align with users' existing comfort and cognition.
▐▌**AR** Similar to Snapchat and Pokémon Go, this applies AR sparingly as an additive element... not a main course.

▐▌**AR** For AR *enablers*, the name of the game is to democratize advanced AR creation.
▐▌**AR** 8th Wall espouses web AR's ability to democratize AR access. It applies the same approach to developers.
▐▌**AR** Ubiquity6 likewise supports web AR and brings tools to people who want to build and own virtual spaces.
▐▌**AR** 6D.ai takes a crowdsourced approach to incentivize spatial mapping creation through a value exchange.

▐▌**AR** For AR *hopefuls*, there's a combination of fresh thinking and following proven methods in AR's short lifespan.
▐▌**AR** Tilt Five eschews the popular concept of *AR everywhere*, in favor of perfecting *AR somewhere*.
▐▌**AR** Its focus on doing one thing well, and straightforward marketing, resulted in **$1.7M** in Kickstarter backing.
▐▌**AR** Like some of the above examples, Tilt Five applies AR to an existing and familiar activity (board games).

▐▌**AR** One key commonality in these businesses (and those in Parts I & II) is the principle of AR *training wheels*.
▐▌**AR** AR is too early and unproven to get consumers to "work for it" or go out of their way to activate it.
▐▌**AR** The most successful forms of AR have conversely applied it as an organic and value-added component.
▐▌**AR** AR will eventually stand on its own, including "native" design, but at this stage needs to build on the *familiar*.

▐▌**AR** The training wheels concept will be examined in a future standalone report with more case studies.
▐▌**AR** Meanwhile, the companies in this report have transferrable lessons that we'll continue to observe and report.

ARtillery Intelligence

▌▌▌ Executive Summary

The consumer AR sector still lingers in early stages. Among other things, this means the playbook is being written mid-flight. There's a great deal of experimentation underway as companies test and iterate rapidly to discover winning formulas and business models.

This goes for consumer AR product strategies. Though a common sentiment in 2016's hype cycle was that AR applies to everything, it's become clear that it's not a silver bullet. It will have native and natural applicability to some aspects of our lives and work… but not all.

Beyond macro categories and use cases where AR should or shouldn't be developed, there are more granular strategies around user experience (UX). What types of AR interactions resonate with consumers? And what best practices are being standardized for experience and interface design?

Equally important is the question of AR monetization and revenue models. Just as user experience is being refined, questions over what consumers will and won't pay for are likewise being discovered. The same goes for brand spending in cases of sponsored AR experiences or ads.

These lingering questions compel acute attention to quantifiable AR market successes and best practices. Not only do the sector's early stages mean that these questions are prevalent… but also that their answers are scarce. That includes evidence of successful execution, as well as transferrable lessons.

With that backdrop, ARtillery Intelligence ventures to find, aggregate and draw meaning from finite AR successes in today's environment. When examining consumer AR engagement and revenue leaders, what product attributes and tactics are driving their performance?

This started in Part I of the report series with **Snapchat**. Its social lenses have the greatest consumer AR active usage, and it holds the leading share of AR ad revenue. Among other things, this is propelled by product-market fit, ease of use, distribution and fulfilling key goals for brand advertisers.

Also on the list is **Pokémon Go**, which we examined in Part II of the series. Though the tech press has moved on to other shiny things, 2019 marks its best revenue performance to date. This is attributed to innovation cycles that breed ongoing novelty and replayability, as well as its sparing use of AR as a game element.

After examining these proven leaders, we now turn attention in the third and final installment of this series to emerging players that show signs of potential. Though earlier and unproven, they show promise and adherence to best practices examined in parts I & II. And they show new best practices worth noting.

These upstarts include **8th Wall**, **Ubiquity6**, and **Tilt Five**. They also include established brands entering AR, such as **Houzz**, **Instagram** and **Pinterest**. This seemingly random sample shows signs of product and business model traction, which we'll examine in the coming pages. The goal, as always, is to triangulate best practices and extract tactics and takeaways for AR players today.

Introduction: AR's Next Class

Much can be learned from consumer AR's early leaders. What are they doing right? How are they engaging users? And how are they making money? These are key questions in AR's early stages, as there's no standardized playbook quite yet. This also makes successes and transferrable lessons scarce.

Given the rigor applied to market watching – through typical analyst work and daily editorial coverage at our sister publication, *AR Insider* – we collect these lessons. They're not easy to find, often fragmented in insider discussions, product reviews and conference presentations. So it's all about synthesizing them.

But before diving into the tactical lessons we're tracking among AR leaders, who are they? First, to define the segments included in this three-part series, its narrowed to consumer-based AR. Industrial AR is an important, but separate, topic we'll continue to track.i

For example, **Snapchat** has achieved the greatest active AR usage, and the most revenue from sponsored AR lenses from brand advertisers. This is attributed to several factors we examined in Part I of this report series, including its ability to reach an AR-forward audience in targeted ways.

Sticking with AR lenses as a format, **Facebook** is also worth watching. Though **Snapchat** has greater focus on AR – congruent with its "camera company" designation – **Facebook** has greater global scale. This raises questions if it can eclipse Snapchat over time as the AR advertising revenue leader.

That's where **Instagram** comes in, as we'll examine in this third and final installment of the report series. Though it only integrated AR lenses recently in August 2019, it has a potentially strong product-market fit given its camera-forward audience. It's also cultivated a use case around shopping and product discovery, where AR could find a natural home.

Speaking of shopping, we'll also examine **Houzz**. It stands as an exemplar in the category of players that aren't AR companies, but have adopted AR and have developed notable best practices. We'll also examine smaller AR startups that show lots of early promise, including **8th Wall** and **Ubiquity6**.

What are these players doing right? And what can we learn from them? We'll tackle these questions in the coming pages through in-depth profiles of each company. After covering **Snapchat**, in Part I of this series and **Niantic** in Part II, this will be the chance to drill down on the consumer AR sector's less proven – but still promising – next class. Altogether, there will be key lessons to extract.

Image Source: Tilt Five

AR Converts

The companies in this report represent a range of consumer AR approaches. The seemingly random and disparate sample was chosen for specific reasons and pattern recognition. As a related side note, any AR companies omitted from this report shouldn't be viewed as deficient or less promising.

Some of these companies are established players moving into AR (*AR converts*). Some are AR-native players building tools and technologies to advance the state of the art

(*AR enablers*). And some are players just out of the gate and showing promise to represent AR's next phase (*AR hopefuls*).

We'll go through these companies one by one, starting with the biggest companies moving into AR, followed by smaller startups, tool builders and hopefuls. To kick off that process, we'll start with the biggest – and potentially most impactful – player to recently join the AR fray: **Instagram**.

Instagram

Tech giants' motivations for investing in emerging tech often trace back to their core businesses. This is done to future proof massive sums of revenue. And due to these companies' gravitational pull, they can move large chunks of the market with them. This common pattern will play out in AR.

We've been toying with this "follow the money" exercise[ii] for a while, but it gained steam at **Facebook's** recent OC6 event. Besides the big reveal that it's is working on AR glasses, **Facebook** previewed its work in building persistent spatial mapping, known as Live Maps.[iii]

Just like **Magic Leap** has the "magicverse," this is essentially **Facebook's** own flavor of the AR cloud.[iv] The eventual vision is to have a sort of 3D rendering of the social graph. That

could include sharing information, media and status with friends in 3D space, anchored to people or things.

These are longer-term initiatives to be a sort of "social layer" to the immersive web. But in the meantime, **Facebook** is doing lots of work to acclimate users and developers to AR. This mostly includes lenses, which are today's most popular AR format as we examined in Part I of this series.
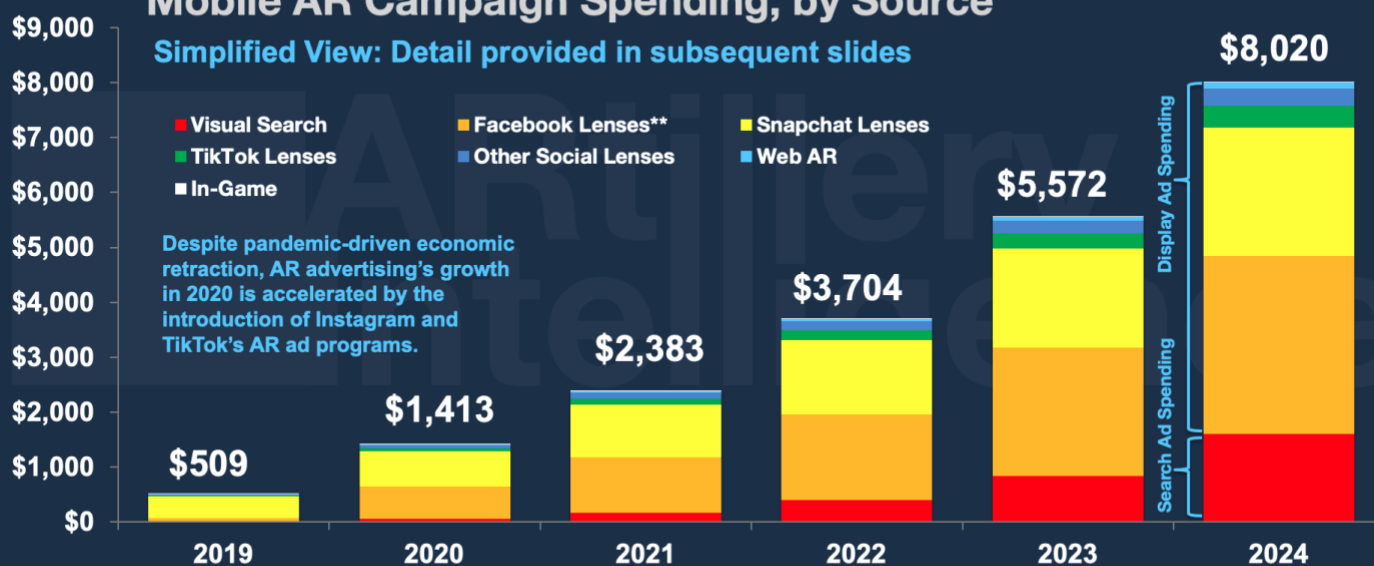
Lenses are also the most *lucrative* AR format today. They let brands demonstrate products in immersive ways and across the consumer purchase funnel. These factors drove **$509 million** in AR ad revenue last year, on pace for **$8.02 billion** by 2024 according to ARtillery Intelligence estimates.

Mobile AR Ad Revenue
U.S. $Millions

Mobile AR Campaign Spending, by Source*
Simplified View: Detail provided in subsequent slides

Legend:
- Visual Search
- Facebook Lenses**
- Snapchat Lenses
- TikTok Lenses
- Other Social Lenses
- Web AR
- In-Game

Despite pandemic-driven economic retraction, AR advertising's growth in 2020 is accelerated by the introduction of Instagram and TikTok's AR ad programs.

Year	Revenue
2019	$509
2020	$1,413
2021	$2,383
2022	$3,704
2023	$5,572
2024	$8,020

Display Ad Spending
Search Ad Spending

*Doesn't include platforms endemic to China
*Doesn't include non-advertising marketing spend such as self-distributed brand apps and experiences
**Includes Instagram, Messenger and all Facebook properties that distribute AR lenses

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Ace up its Sleeve

Most of this activity has been with **Snapchat**, which announced **15 billion** cumulative lens views in May. That's followed by **Facebook** which has served **one-billion** lens views in the 12-months preceding April 2019. That happened through a combination of the News Feed, Messenger and Portal.

These are fitting places for AR, but **Facebook's** real ace may be **Instagram**. Its **700 million** active users and camera-centric use case are more aligned with AR than other **Facebook** properties. Social sharing is also core to **Instagram** which can drive lens distribution virally, just like **Snapchat** does.

These are all reasons why **Facebook** launched its **Spark AR** developer platform on **Instagram**. It was in closed beta for most of the last year, then opened up to the public in August. This isn't enough time to get a good glimpse of its potential for community-created lenses but it's a start.

That will grow over the next year, and it will follow the same progression we've seen on **Facebook's** other properties. This entails a period of user acclimation, community lens creation, followed by monetization. The latter is where brands create and distribute lenses at meaningful scale.

Back to the "follow the money" construct, **Facebook** is motivated to make all of this happen because it's running out of ad inventory on the News Feed. Because that's its core product, which it doesn't want to oversaturate with ads, it's looking to untapped ad inventory in **Messenger** and **Instagram**.

But more than financial motivation, **Facebook** knows AR "fits" on **Instagram** and it wouldn't force an unnatural union. Similarly with **Messenger**, AR-enhanced "conversational commerce" could be a natural use case. And **Portal** has its own AR storytelling use case that's natural, albeit less scalable.

Shoppable AR

Speaking of commerce, the next direction for AR on **Instagram** is shoppable lenses to transact right on the spot. We predicted this in 2018 when it was clear that AR was coming to Instagram. That put AR on a convergence path with **Instagram's** eCommerce integrations already underway.

This has since unfolded as **Instagram** works with top fashion retailers to integrate AR product try-ons as part of the in-app transaction feature they utilize. These integrations are logical, as **Instagram** has become a place for consumers to discover products and transact, especially for fashion items.

AR will now join that shopping flow to make products more demonstrable, pursuant to boosting sales. This continues to be validated by **Snapchat** and others. For example, **Facebook** itself has reported that AR-based cosmetics try-ons have boosted conversion rates by **28 percent**.v

Altogether **Facebook** has several tracks for spatial computing, which will eventually converge. It has primary VR ambitions to connect the world in more immersive ways (and monetization therein); newly-announced AR glasses and Live Maps; and nearer-term mobile AR lenses.

The latter is the least sexy of the three. But it's a key step to get users and developers acclimated to spatial interfaces. That will prime the next era of immersive UX that **Facebook** is aiming for. But in the meantime, mobile AR — potentially fueled by **Instagram** — is beginning to generate real revenue today.
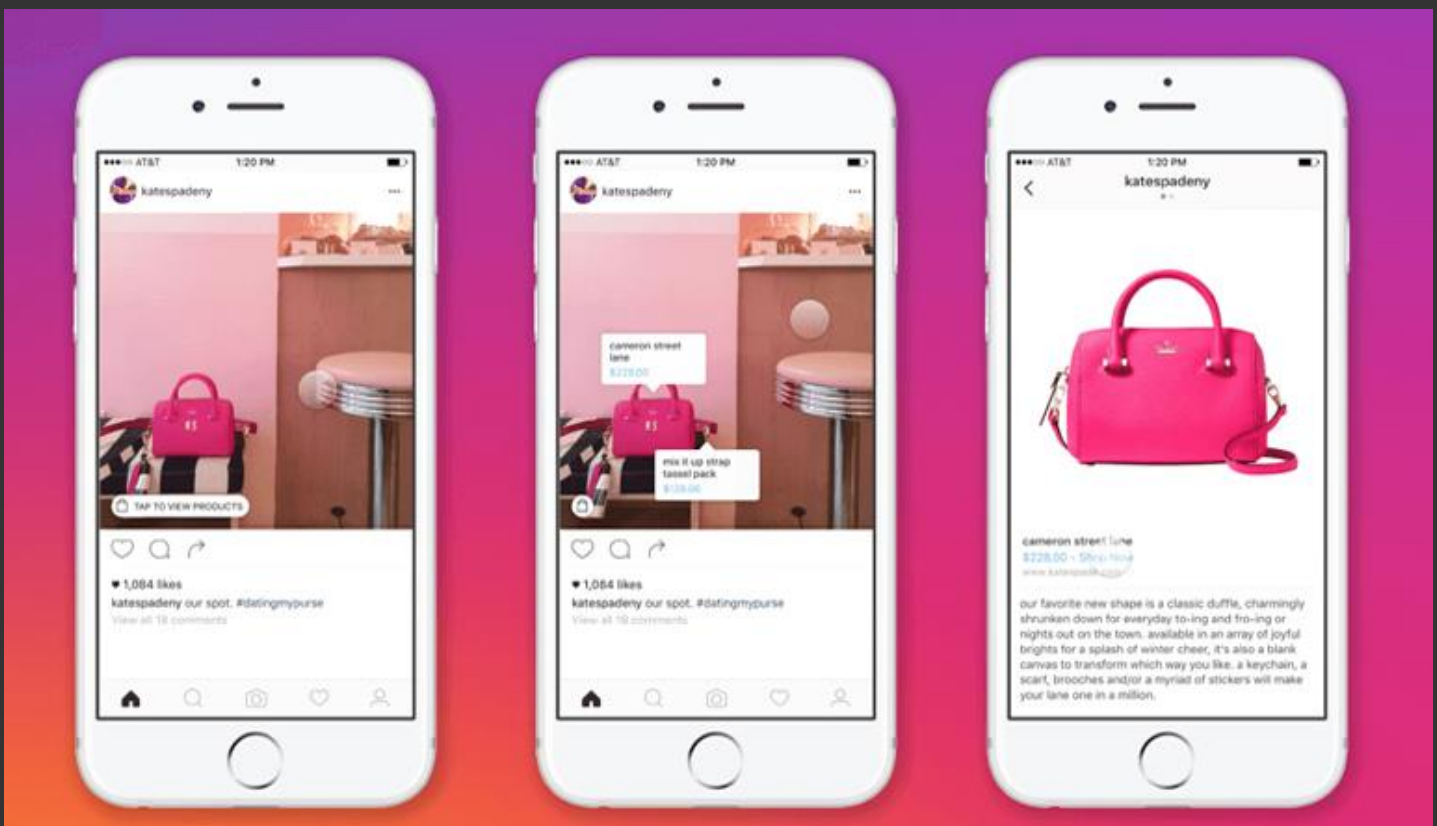
Place AR in Users' Paths

One key practice can already be seen in **Instagram's** AR commerce integrations. As examined throughout Parts I and II of this series, AR is seeing the most success when it is placed directly in users' paths. It should also be integrated in ways that align with users' comfort and cognition.

For example, with the transactional functionalities mentioned above for **Instagram** and other lens providers, the entire purchase funnel happens all in one flow. There's no bouncing users to another app, nor to a website to further browse products and transact. It all happens in one place.

This is important in AR's early stages of consumer adoption when it isn't yet proven enough to compel users to go out of their way or "work for it." This involves the AR-as-a-feature approach which integrates AR in sparing ways that are organic and additive to an already-prevalent activity.

There are a few players who live by this principle, including **Snapchat** and **Niantic** as examined in previous installations of this series. In fact, their success has validated the practice and was one criterion used to select the AR exemplars in this report. Next on that list: **Houzz**.
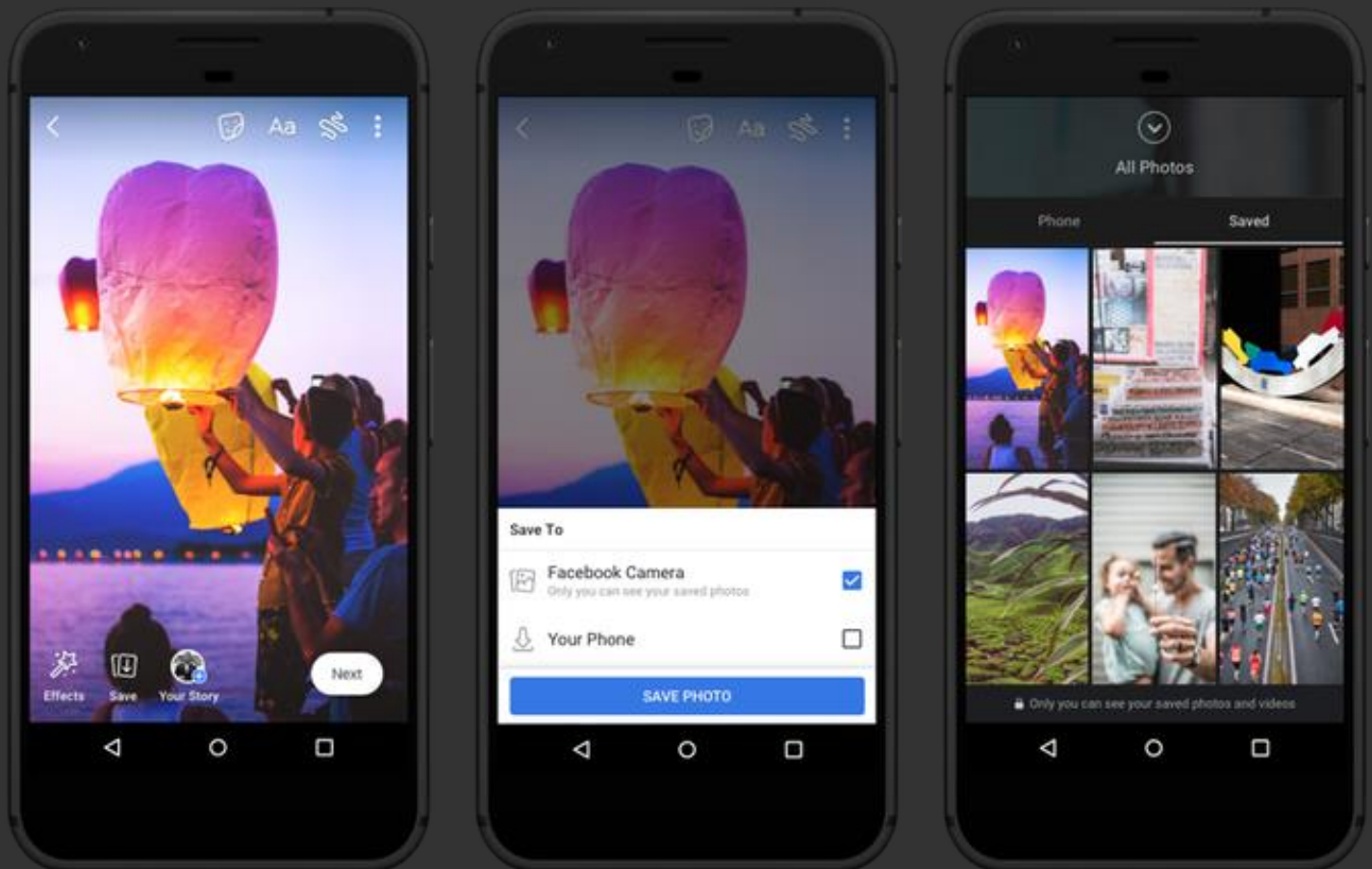
Houzz

One company that's received considerable accolades for AR commerce is Houzz. The home furnishings company offers AR to visualize products prior to purchasing. Its 11x boost in conversions from AR visualization is one of AR's most cited data points.vi

But how did it get there? Much of this success came under the tenure of Houzz' visual tech lead Sally Huang. In fact, her title alone demonstrates the company's commitment to AR. She joined Houzz four years ago to bring visual technologies into the mix, though AR wasn't the obvious path initially.

This started as a 2D version of its now popular AR "View in My Room" feature. It used flat stickers for in-room furniture visualization. Though primitive, Houzz operational scale gave it large-sample demand signals by which to test and iterate features. All signs pointed to keep moving towards AR.

"The mobile team took product photos, removed the background and used them as stickers," she said at the AWE conference. "They were able to apply this to just about any photo in the library… so if you were shopping for anything, there was an opportunity to view it in your room as a 2d sticker."

With just that 2D sticker, Houzz saw a 3x boost in conversions. This was enough to get it thinking about more spatially-advanced integrations. Notably, this was before Apple's ARkit so like other AR pioneers at the time, it had to do lots of in-house development.

"It seemed like too much of a technical challenge, but when we saw the success… it became obvious it was something we had to work towards," said Huang. "If you were able to get such good results with 2D, imagine what it would look like [with] a full 3D integrated experience."

WHEN AR FEATURES ARE USED IN APP, CONSUMERS…

ARE 11X MORE LIKELY TO PURCHASE.

SPEND 2.7X MORE TIME IN APP.

SOURCE: HOUZZ

© ARtillery Intelligence, 2020

The Shopping Flow

Fast forward several product cycles later, and Huang's team was ready to hit the ground running when ARCore and ARkit finally did release in 2017. It was able to take all the work it did and integrate these new native libraries for better functionality like tracking, scale and light estimation.

More importantly, all of that previous iteration and integration of View in My Room taught Huang & team an important lesson: AR needs to be in the shopping flow. It discovered through large-scale testing that AR features within users' existing shopping path outperforms "standalone" AR.

"Part of what we think made our experience so successful was that we really had to answer the question of AR visualization in the shopping flow," said Huang of the design principle also known as 'AR as a Feature'. "So you can basically do the visualization, pop right out and check out."

The result of all of this was the now-famous **11x figure** shown above. The tactics that got it there were iterative product cycles, listening to customers, following usage data closely, and not requiring "activation energy" for users to access something new and unproven like AR.
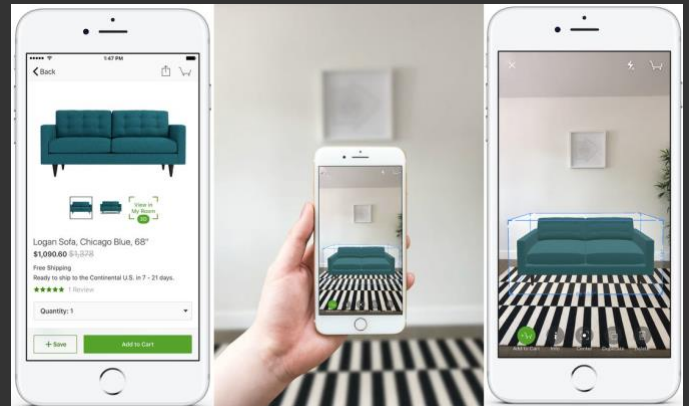

Now, Huang and team are doubling down on these tactics and principles. Just as they've been conditioned to create clever hacks out of necessity, they're now doing the same to reconcile ARkit deficiencies like advanced vertical plane detection. After all, lots of **Houzz** products go on your wall.

"People buy ceiling products, people buy wall products," said Huang. "So we basically spent a lot of time really thinking about the simple gestures we can introduce into our features to vastly expand on the amount of functionality and the amount of categories that we can handle."

Another important tactic is to make AR intuitive. ARkit and ARCore provide a great foundation. But it's just that: Some degree of customization is needed for optimal UX in specific product classes, which is a good lesson for any AR-curious retailers. It's all about making it *predictable* for users.

"When it came to user experiences, we basically opted for predictability," said Huang. "You know, at the end of the day, AR itself has some unpredictable behaviors built-in. So wherever you can, as a design philosophy, [you should] introduce predictability. We basically follow that as a rule."
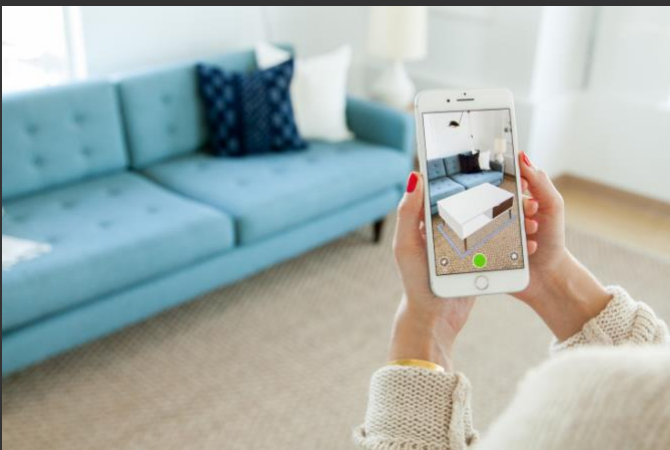
Pinterest

Product visualization, a la **Houzz** and **Instagram**, is just one flavor of AR that applies to commerce. Another is *visual search*. It utilizes computer vision and machine learning to identify items you point your phone at. To sidestep tech jargon and acronyms, Google calls it "search what you see."

The utility inherent in such a tool makes it one of our top pics for formats that could birth AR killer apps. This aligns with past ARtillery analysis and predictions[vii] that AR will begin to transition into more mundane utilities that serve practical purposes at high frequency... sort of like what **Google** did with web search.

Speaking of **Google**, it's the front runner for visual search. It has the knowledge graph, image database for object recognition, and other underlying tech that will carry over to a

visual search world. More importantly, it's highly motivated to make visual search happen, as we've examined.[viii]

But another player could vie for visual search market share: **Pinterest**. The publicly-traded media & commerce player is likewise positioned with an image database and AI chops. It has a narrower use case than **Google** — mostly around consumer products — but that focus aligns with monetization.

To validate this potential, it recently announced that **Pinterest** Lens — its visual search feature — recognizes **2.5 billion** objects, mostly fashion or home-related. This notably beats **Google** Lens' **one billion** products recognized. Though in fairness, **Google** announced that figure more than a year ago.

Commercial Intent

Beyond volume, **Pinterest's** advantage goes back to its product focus. **Google**, being **Google**, will likewise monetize **Google Lens'** "lean-forward" user intent to contextualize physical world items. That could be highly monetizable in fashion and local discovery. But it's not there yet.

Instead, **Google** has focused its marketing for **Google Lens** on general interest visual searches like pets and flowers. This is to build broader organic demand by focusing on widely-familiar search subjects (a la "training wheels"). Monetization will come after user engagement hits critical mass.

But it seems **Pinterest** is closer to that point with an inherent use case around product-based (monetizable) visual search. That likewise aligns with its product persona. A "search what you see" proposition for fashion items and home goods is a natural extension from everything **Pinterest** has built so far.

And it's proving out in terms of user traction. **Pinterest** has announced that **80 percent** of Pinners start with visual search when shopping vs. **58 percent** of non-Pinners.ix This commanding share is notable because visual search hasn't really acclimated yet as a common consumer behavior.

Back to **Google**, competitive advantage could conversely lie in underlying technology to surface the best results, and it's hard to bet against **Google** there. **Google Lens's** object recognition is built from **Google's** machine learning, knowledge graph and training set from years of indexing images.

So **Google** and **Pinterest's** respective visual search plays will co-exist for different use cases but also compete and overlap in some ways. Others will compete, such as **Snapchat**, which not only has a "camera-forward" AR user base, but has intelligently partnered with **Amazon** for visual search.x
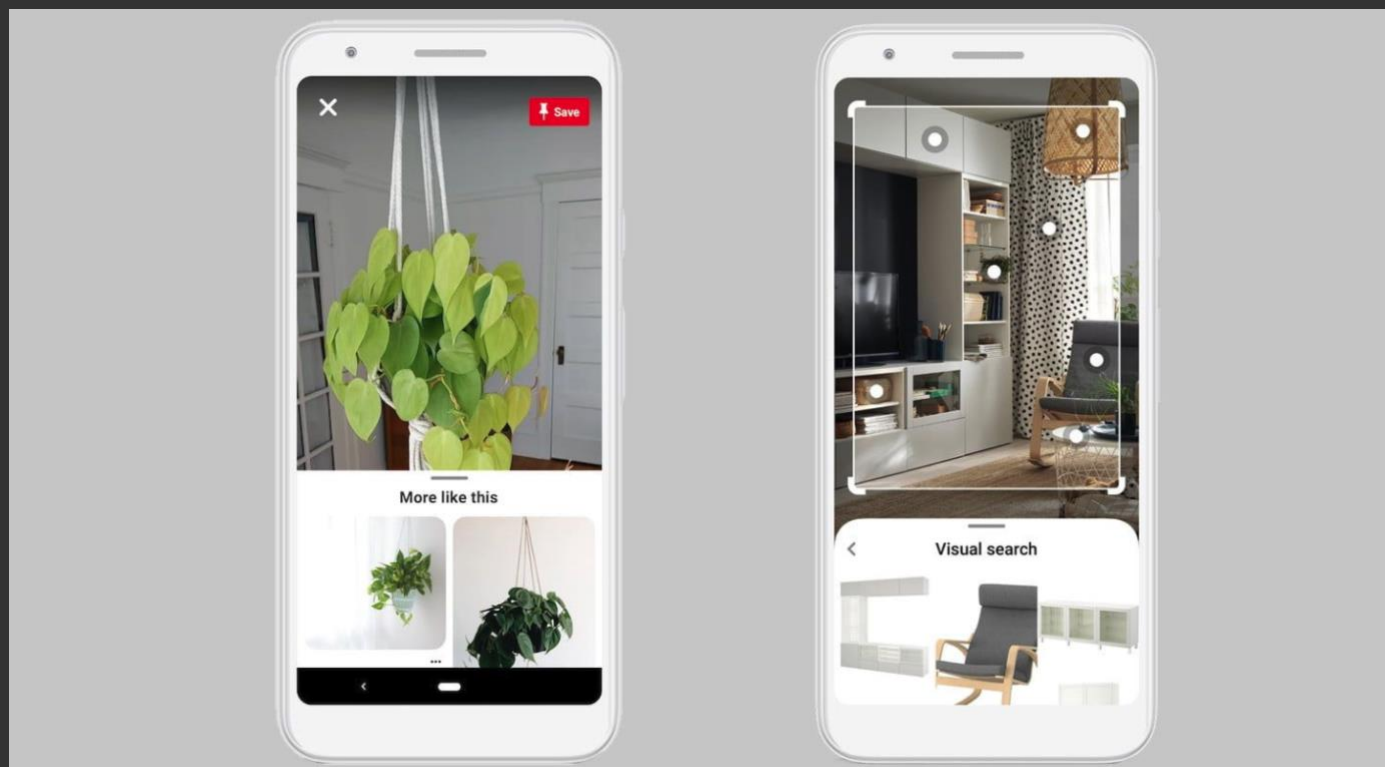
Competitive Edge

Another key competitive edge will be to make visual search easier to access. **Google** has taken steps to accelerate Lens by incubating it in its pervasive search products. And that's needed, as there are still too many screen taps to launch a tool that isn't proven enough to justify the activation energy.

As these things evolve, visual search could germinate AR killer apps. It not only moves beyond fun & games to achieve true utility (what AR needs), but it's inherently a high-frequency use case. In that way, it follows patterns of mobile search — in both usage patterns and monetization potential.

Speaking of mobile search, one lesson is that proximity to search subjects (e.g. restaurant search when near the restaurant) can boost "intent" and key metrics like CTRs and CPCs.

Visual search takes that proximity to another level, given that search subjects are literally in-view.

That's amplified when visual search is used in commercial contexts such as store aisles. **Pinterest**, again, has an underlying commercial context to its engagement which makes it a sleeping giant in visual search. But **Google's** gravitational pull and knowledge graph are formidable.

Whether it's **Pinterest**, **Google**, **Snapchat** or others, visual search and AR in general need more business cases to counteract the broader market's growing doubt. We'll be watching as innovation, product positioning, and user behavior coalesce into revenue-generating AR products.
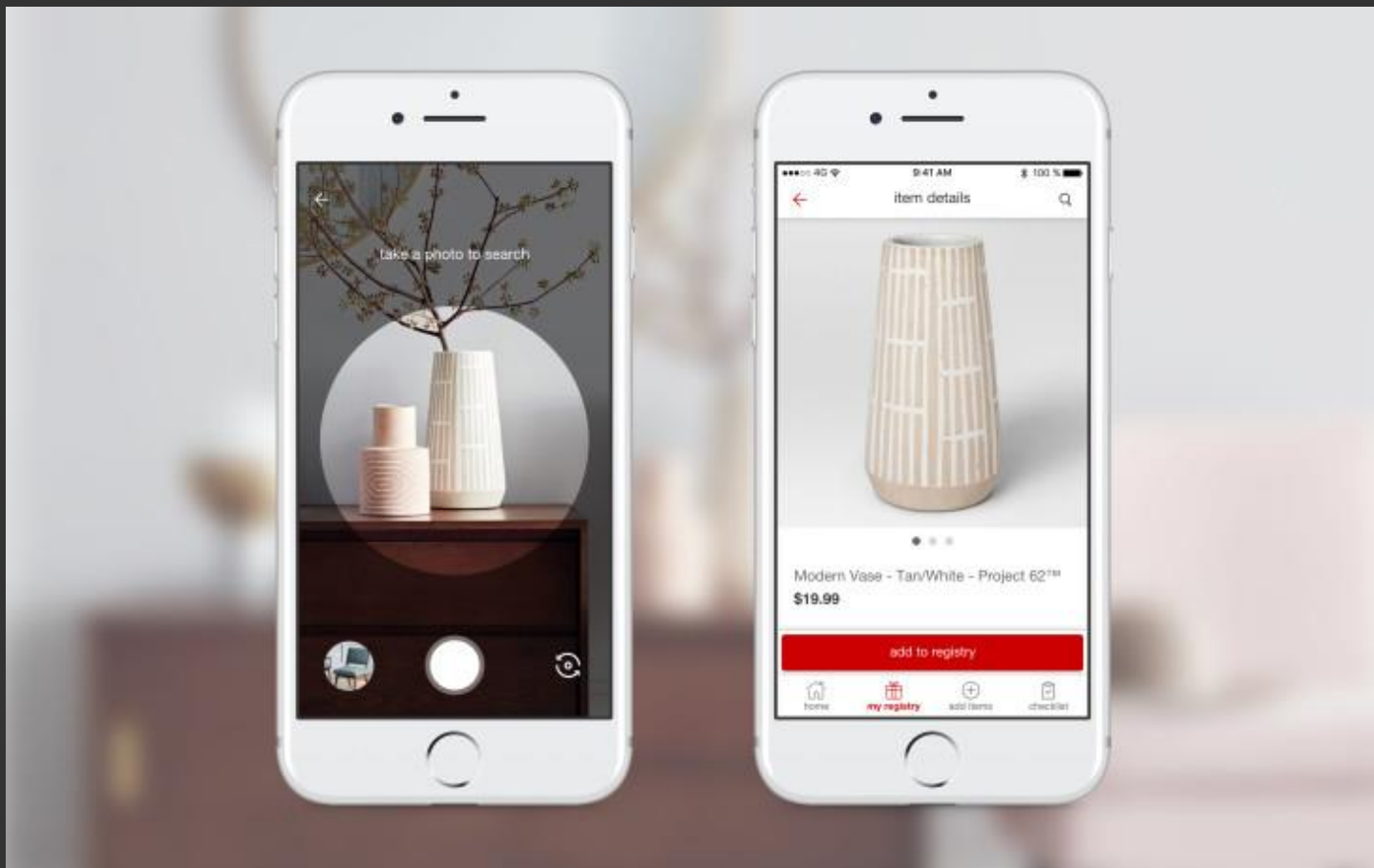
# Companion Video: *What's Working in AR Advertising & Commerce*

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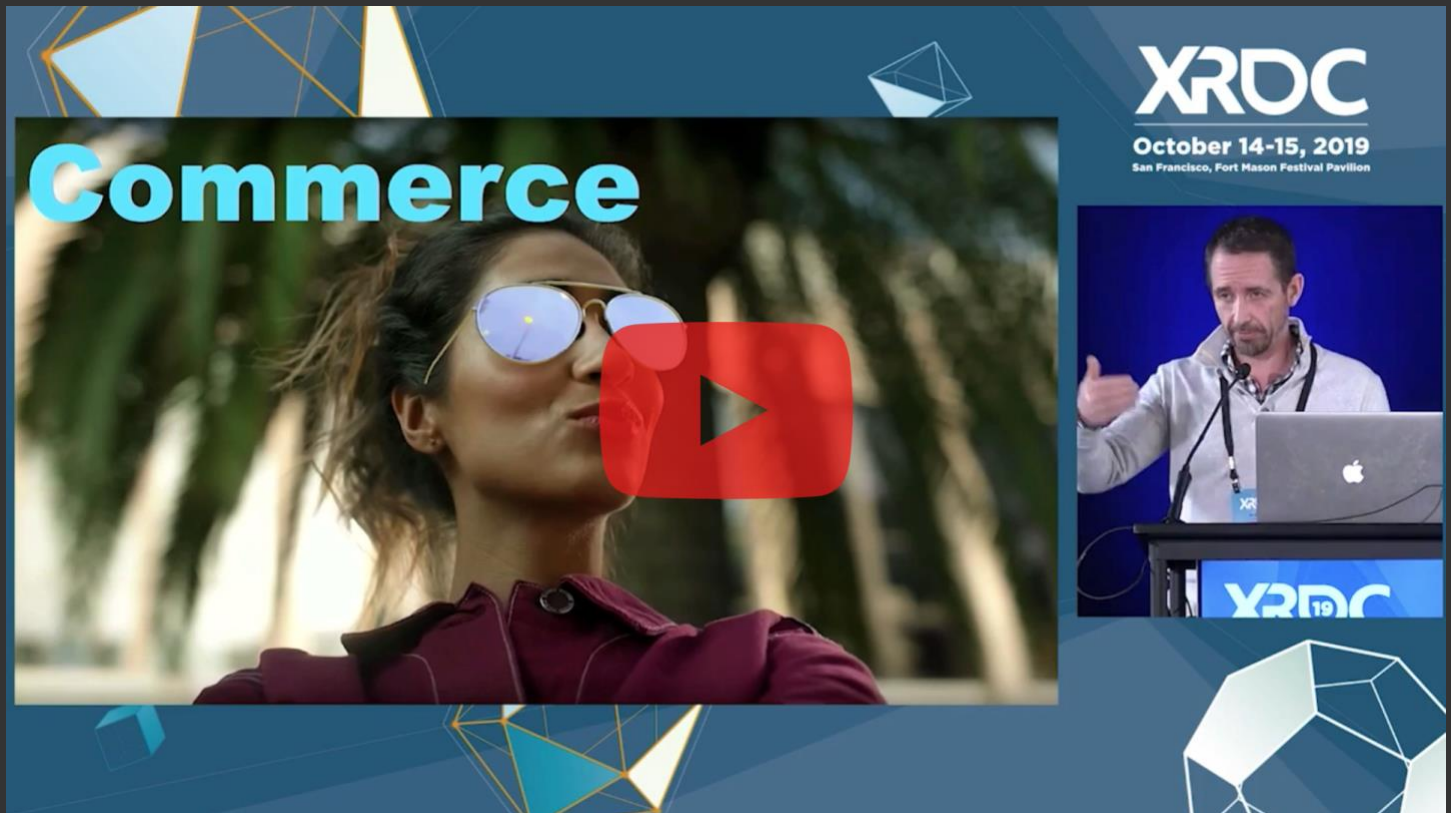
AR Enablers

After covering a sample of *AR converts*, it's time to move on to the AR tool builders. Congruent with an ongoing theme of this report series, these startups represent the "picks & shovels" that are lowering barriers to AR creation. They'll be a key part of the ecosystem and the companies profiled in the following pages are just a few representative examples.
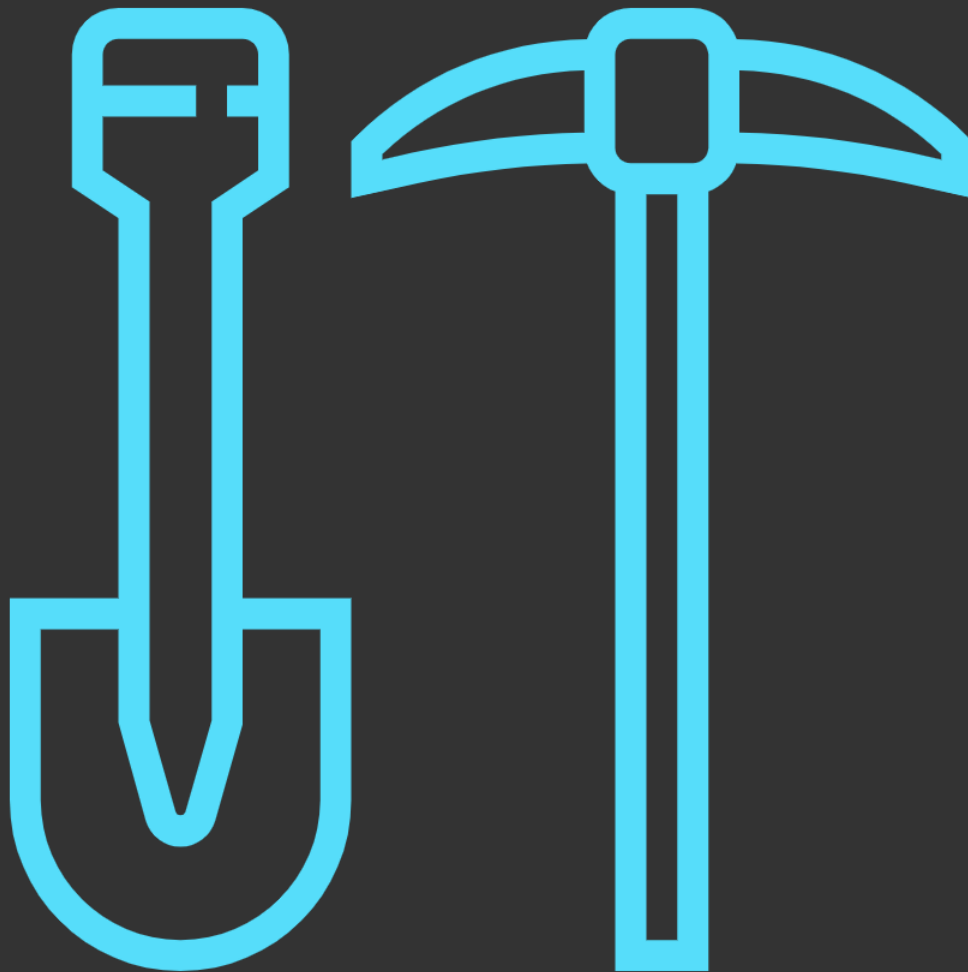
8th wall

There's growing realization that apps aren't the optimal vessel for AR. Yet with mobile AR, it's born on a device where apps rule. **90 percent** of mobile users' time is spent in apps versus the browser. Can AR break that cycle and instead condition users towards the web?

This involves AR that's launched from the mobile browser. Advantages include dynamism for AR's serendipity and short sessions, versus the friction of app stores and downloads. All that "activation energy" dampens AR adoption, which is already challenged by its nascent and unproven status.

Put another way, do you want to spend **90 seconds** downloading an app for an experience that lasts 30 seconds? This could be the case in dynamic AR activations like within a store aisle, or reading an online article, or even longer sessions like a multiplayer AR pick-up game in the park.

"Web AR has some nice advantages," **8th Wall** CEO Erik Murphy-Chutorian told ARtillery Intelligence. "You're not tied into a social network, you're not tied into a platform, you don't have to go to an app store and you aren't restricted on devices. You really can get on most peoples' phones."

8th Wall's eponymous 8th Wall Web is an AR engine that works on mobile browsers. Built on standards-compliant JavaScript and WebGL, it has SLAM, positional tracking and some of the trappings of "true AR" seen in native apps, but without the bloat and activation energy.

This approach has attracted Sony Pictures, Miller Lite, and Porsche as clients for promotional AR experiences. It powers more than **5,000** web AR apps and reports that **80 percent** of its AR activations have session lengths greater than one minute, and **50 percent** are greater than two minutes.
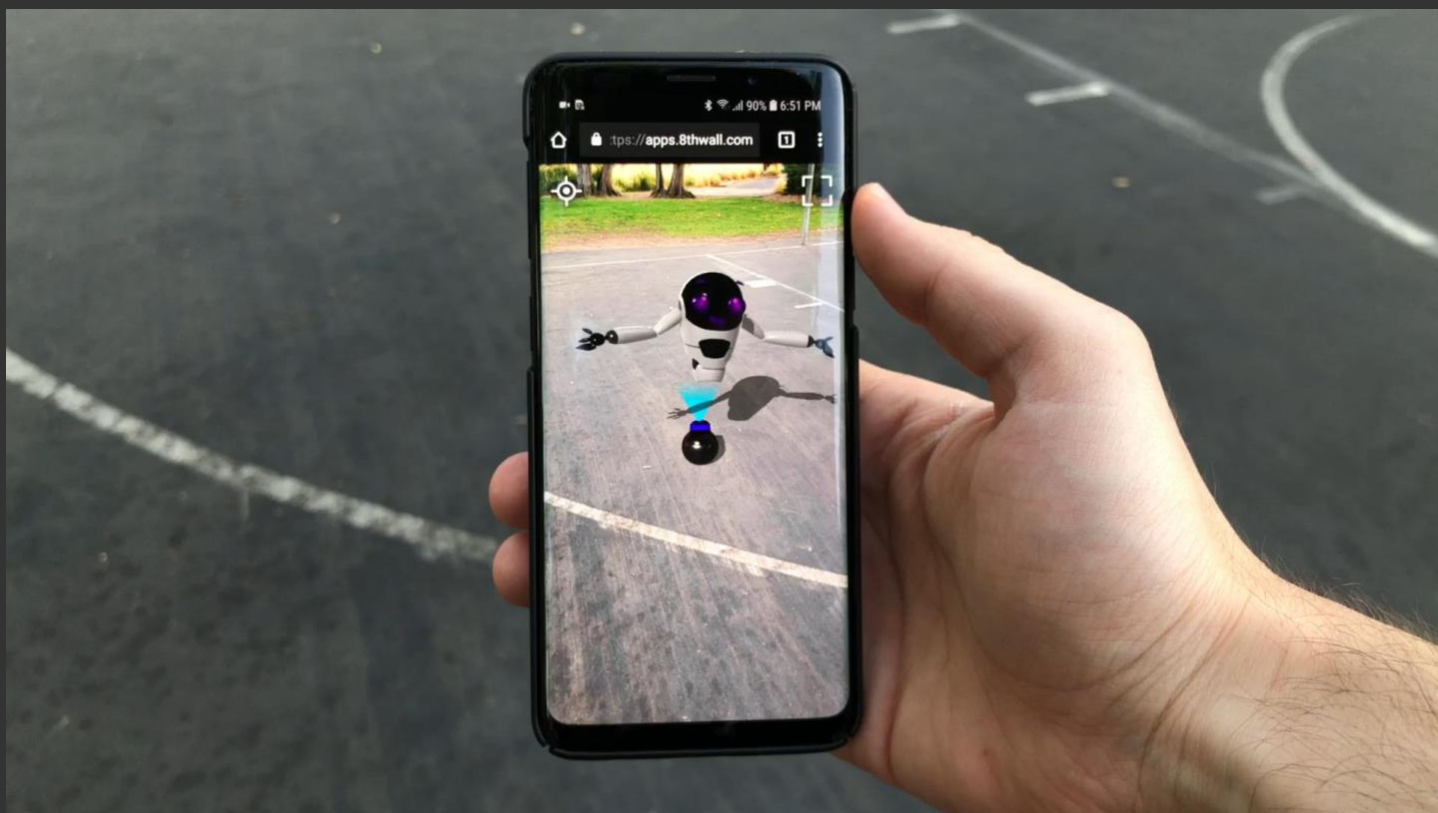
Advantage, App

As further background on apps versus web AR, Murphy-Chutorian admits that apps can have some advantages. For one, they can more-directly tap into device sensors when using a native platform such as ARkit that has purpose-built vertical integration with the hardware.

"Apple specifically has done a really good job of getting accurate scale in AR," said Murphy-Chutorian "There are things like measuring if my suitcase fits inside a box, or virtual tape measures. They've done an excellent job getting the accuracy right for those things."

As for practicality, apps work well when it's something you use frequently, such as the small tray of daily-use apps like **Facebook**, email, messaging or a game like **Candy Crush**. For these few use cases, home-screen positioning and quick access can be well served by native apps.

"Apps are really good for these things that you come back for all the time, like if you're going to sit there checking your **Facebook** feed multiple times per day," said Murphy-Chutorian. "It's almost like apps are a commitment: once you have that level of commitment, they're appropriate."

Advantage, Web

But some of these app advantages only apply to a limited set of high-use apps. And for newer apps, getting into that exclusive club is near impossible. So for any app developer building something today — especially in the still unproven AR category — the calculus is different.

"Say you're a new company and you want to do something in AR… you build a native app and put it in the store. How many downloads do you get?" posed Murphy-Chutorian. "People really struggle to get their apps downloaded, and their reach and visibility is much smaller."

But things open up a bit in web AR, as you can plant universally-operable web links wherever you have existing presence. That includes everything from your website to social media to physical store signage. It also includes emerging AR distribution channels like email and messaging.xi

"Any source of traffic you have becomes an opportunity to show AR," said Murphy-Chutorian. "Another great area for reach is people who own restaurants, stores or sell goods that are printed on anything. It's AR on the back of the toy you just bought or the cereal box or Starbucks lid."

Along with that comes functionality for all the things the web does, added Chutorian. If operating outside of apps or social walled gardens like **Facebook**, you can connect the AR experience to your payments processor, or integrate the **Google Maps** API for location-relevant content.

"Those kinds of web combinations let you build much more powerful things than what you can do on AR apps and social networks."
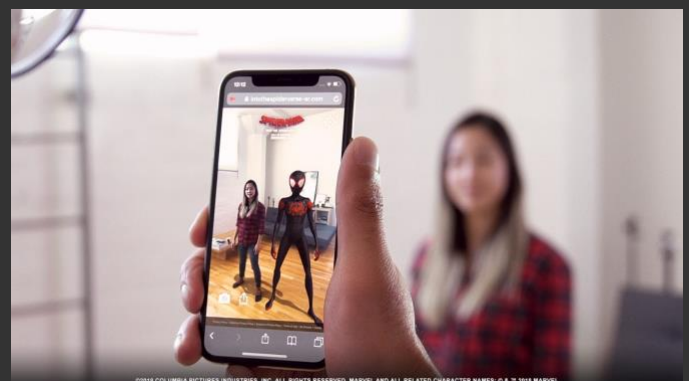

Image Source: Universal Pictures

Numbers Game

These types of commerce outcomes could represent AR's next phase, as it graduates from novelty to practicality. The same goes for advertising, which is consumer AR's leading revenue source today, as examined earlier, and projected by ARtillery Intelligence to grow to **$8.02 billion** in spending by 2024.

But this vision requires more users for reach-driven brand marketers to get on board — another area Web AR could be advantaged. Going beyond the oft-cited "**1 billion**" ARCore and ARkit installed base, ARtillery Intelligence recently quantified the full slate of mobile AR unit compatibility across all platforms.[xii]

Among them, Web AR has the biggest growth capacity given that it has the greatest device compatibility (see chart below) but the least active users. Along with all of web AR's

technical and practical benefits explored above, this scale and head room could be a big confidence signal.

Furthermore, this mobile AR market-sizing exercise reveals another key factor: platform fragmentation. Compared to the mature smartphone market that has two platforms, AR (and VR for that matter) have several, which could further compel web AR and its cross-platform advantages.

"Magic Leap is building a software ecosystem around its product. Microsoft is doing the same with Hololens. Oculus, HTC and Playstation are doing it in VR," said Murphy-Chutorian. "But it may be that if there is no dedicated winner, the winner becomes something that works across all of them."
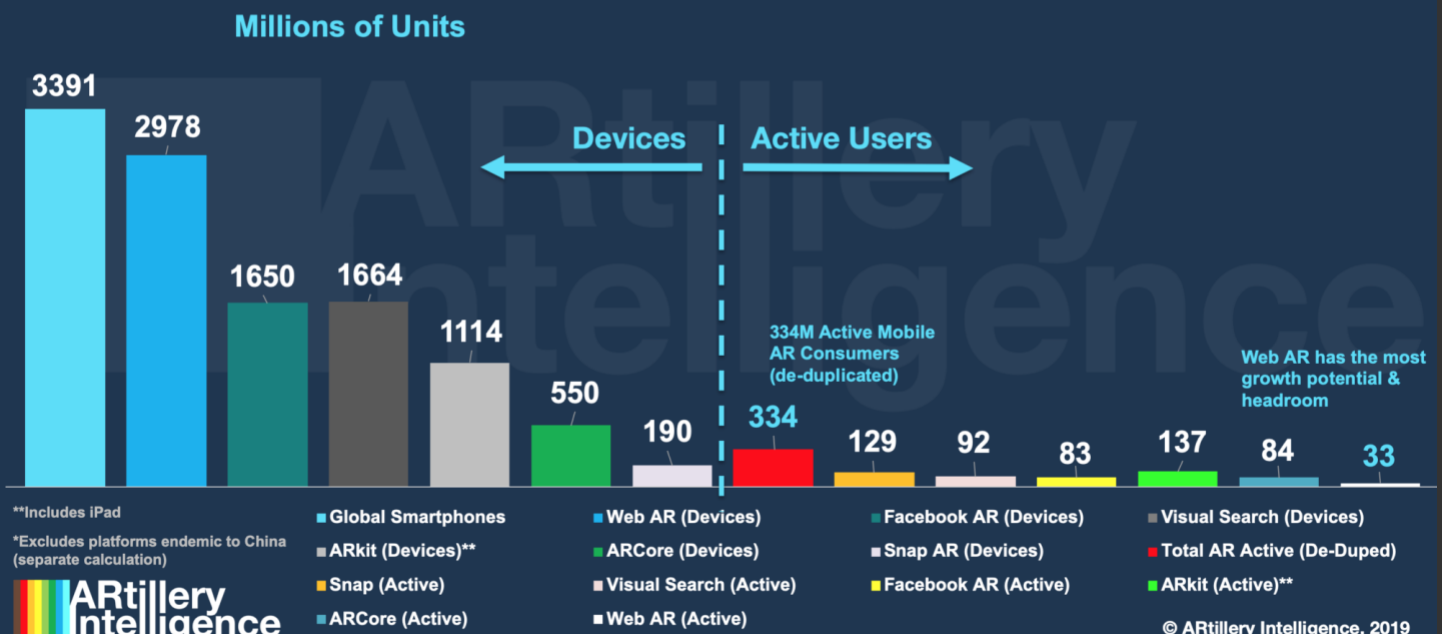
Doubling Down

8th Wall recently doubled down on the above principles with a web-based authoring and hosting platform. This lets developers author AR experiences in-browser without third-party software or server setup. It essentially bottles up Web AR's user-facing advantages and brings them to developers.

Using the platform, AR developers will be able to collaborate from anywhere in the world. They'll also be able to quickly view and resolve conflicts with an in-browser distributed version control system. This includes staging environments to test, publish and host Web AR projects.

The new platform essentially means less friction to get up and running with AR, which will appeal to those with less technical resources or far-flung teams. It also makes sense to lower barriers at a time in AR's early lifespan when there are enough barriers already. It's all about democratization.

"What we are launching democratizes AR web development," **8th Wall** VP of Product Tom Emrich told us. "Our platform aims to reduce the time to get sophisticated WebAR activations to market by enabling collaboration between large teams and removing other barriers developers face."

Image Source: 8th Wall

Image Source: 8th Wall

One of the reasons this is important in a macro sense is to bring AR to more creators and thus consumers. The idea is to demystify AR and bring it into intermediate realms of creative development. That includes designers at ad agencies or even in-house brand marketers.

"Before this release, web developers needed to get our source code from GitHub, use third party tools to code, and set-up their own servers to test and launch," said Emrich. "**8th Wall's** authoring and hosting platform is one place to do this all."

In addition to "democratization tools," this falls into a category of AR spending we call B2B2C. It's enterprise AR software but delineated from the common connotation of "enterprise AR" for industrial automation. B2B2C is rather SaaS (or ARaaS) for brands to build AR for *their* customers.

This is one of three top AR business models examined in a recent Artillery Intelligence report.xiii It will enable and accelerate the AR supply side, which will in turn acclimate the demand side (consumers) and work towards the flywheel effect that AR needs.
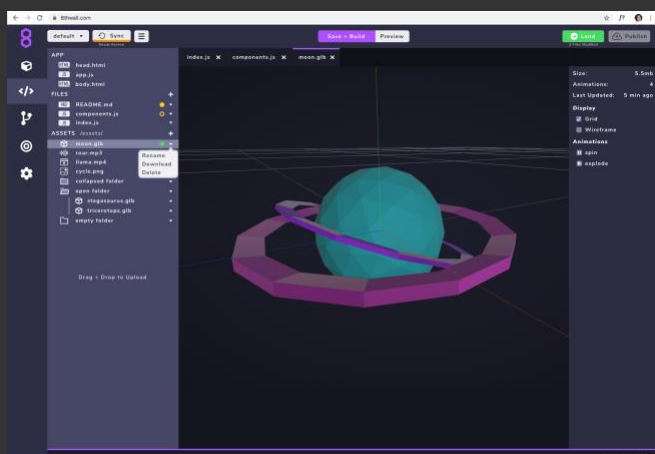
Ubiquity6

One aspect of the AR world we all envision is that it's persistent and synchronous so that we can experience things together. Popular AR to date is mostly asynchronous by comparison, such as recorded videos of selfie masks on Snapchat, shared and viewed later by a friend.

But synchronous sharing, along with image persistence and other key functions, are the promise of the AR cloud and the next phase of social AR. Another way to think about this is a sort of real-world version of a multiplayer online game like World of Warcraft, Ubiquity6 CEO Anjney Midha told us.

"Our goal is to bring people together in real-world spaces for valuable, shared experiences made by any kind of creator," he said "Today, we're focused on a product that lets anyone easily create and launch shared AR moments using the mobile camera they have in their pocket."

This vision will materialize through the company's spatial browser (user-facing) and Reality Editor platform (creator-facing). By putting deliberately low-friction tools into the hands of users and creators, it hopes to engender a scalable and self-propelled ecosystem for AR experiences.

This ecosystem consists of Ubiquity6's three main constituents: Curators, creators and users. Curators establish and moderate AR experiences. Creators build the AR graphics to populate experiences. And users consume and edit the experiences. These can all overlap.

Image Source: Ubiquity6

Democratizing AR

For many of the same reasons as 8th Wall, Ubiquity6 has built its platform around a web stack. That means any web developer can create AR experiences using the skill set they already have. This will be key to jumpstart the ecosystem by populating it with content faster.

"The barriers to making shared or persistent experiences in real-world spaces are incredibly high, especially for the 20 million+ creatives and developers who make things for the web," said Midha. "They have to pick a game engine, learn a new language like C#, understand the black magic of computer vision, multiplayer networking, server infrastructure and then duct tape it all together."

Friction is also reduced for users, given that they only need a web link to launch an experience. Today's app paradigm conversely won't work for AR — especially synchronous AR where dynamic "pick-up" experiences are hobbled by requirements that everyone stop and download an app.

Proof of Concept

To further accelerate and seed adoption, Ubiquity6 wants to jumpstart AR experiences that are built on the Reality Editor platform. To do this, it's deploying shared AR experiences in well-traveled places — a sort of inspiration or proof of concept to get the ball rolling.

"We think creators should be easily able to publish experiences for users to find in public spaces," said Midha. "Users should be able to easily take those experiences with them to their own private spaces when they want to. We support this flow as a first-class citizen."

The largest-scale effort so far was at SF MOMA in August, where Ubiquity6 created a shared AR experience that let patrons add virtual blocks to a digital installation. The piece

built up cumulatively and persistently over time from users' collective contributions.

Beyond the intended effect of inspiring creators and users, the exercise revealed key behavioral and business model indicators. The biggest takeaway was that there can be exponential growth in user engagement and value as the number of players increases — a classic network effect.

For example, the average session length was 45 minutes, which far exceeds typical 1-2 minute AR experiences examined earlier. Midha believes this is due to specific game mechanics that arise with large-scale collective play. These include both competitive and collaborative dynamics between players.

"We learned that it's not about the quality of graphics, depth of gameplay, or clever ways to give people badges or points: The shared experience itself is the reward," said Midha. "The ability to place a creation, precise to a few centimeters, in a real-world space in a way that appears and updates for hundreds of other viewers in real time was hugely rewarding."

Beyond sociological aspects, there are spatial dynamics. With such experiences, there's an opportunity to derive value from the fundamental economic principle of scarcity. And users with access to a given AR space feel a sort of exclusivity… potentially to the point of paying for it.

Spaces and Faces

This all raises the question of how **Ubiquity6** will make money. Midha, a former investment partner who founded Kleiner Perkins' Edge seed fund (**Magic Leap**, **TheWaveVR**), is more pragmatic and finance-minded than most. With **$37.5 million** in funding, he's forthright about monetization paths.

He's certain that the business model *won't* be advertising. Like we've heard from **6D.ai** and **Magic Leap**, ad models aren't aligned with user interests and are a minefield of data collection conflicts. Instead, Midha wants to cultivate the innate human need to personalize our spaces and faces.

This can be seen in everything from fashion (analog) to **Fortnite** (digital). At the intersection of those phenomena is a likely sweet spot to administer a marketplace for accouterments that adorn AR experiences. This could also incentivize AR creators to build things with **Ubiquity6**.

Along with lowering technical barriers, that incentive could accelerate a network effect by getting over the classic "chicken & egg" hump of supply-constrained markets. This challenge is rampant in online marketplaces, much less ones that are built to the physical scale of the inhabitable earth.

It's a large feat, but **Ubiquity6** has the approach and pedigree to pull it off. That starts with digital blocks on museum ceilings, then use cases that creators run with. The key is an AR-native toolset to enable that creativity, and to connect it with users: "We're doing it AR-first," said Midha.
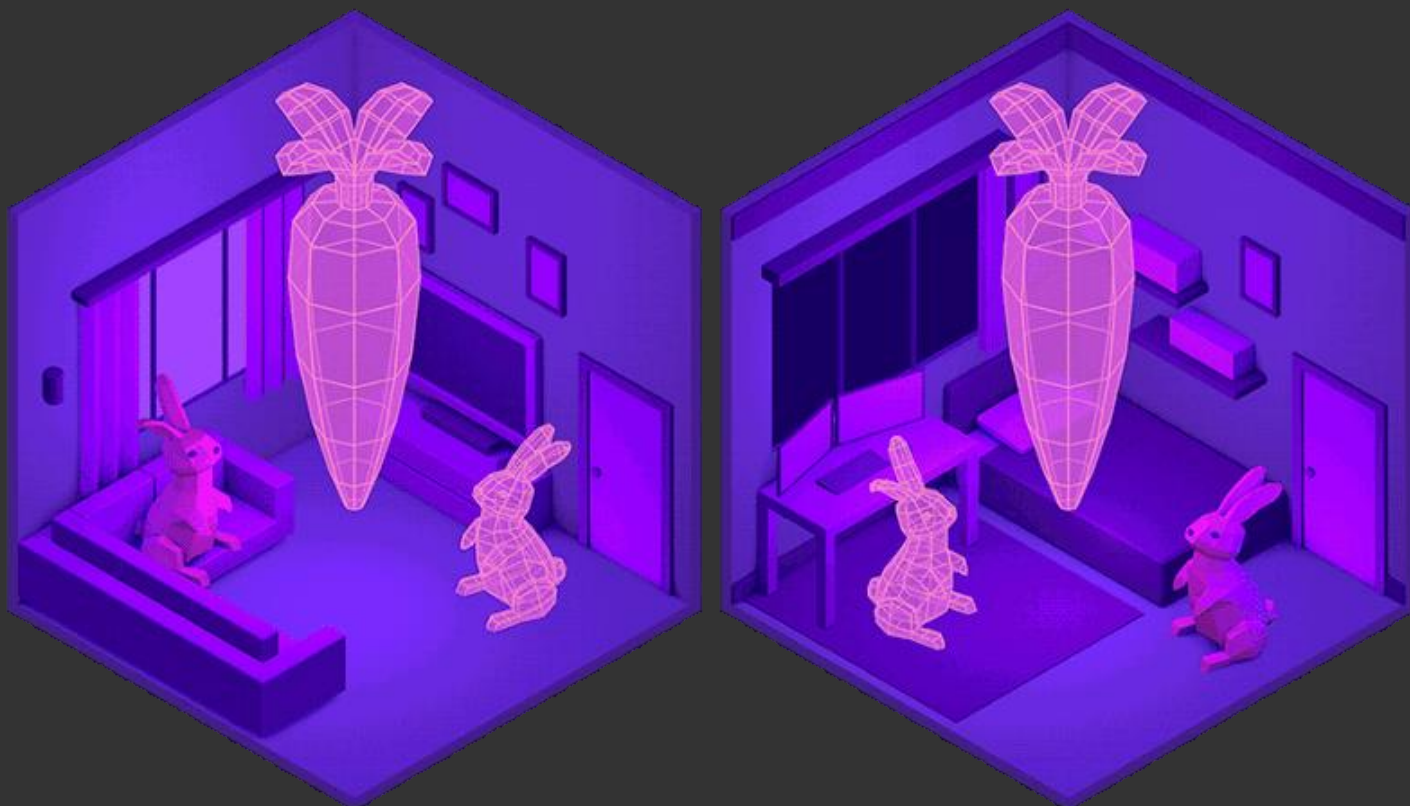
Image Source: Ubiquity6

Wisdom of the Crowds

One of the challenges faced by **Ubiquity6** and others that are trying to build proprietary AR clouds, is doing so on the scale of the inhabitable earth. Creating valuable and relevant geo-anchored content is one thing. Doing it at planet scale is another. The world is a big place.

This has led to lots of creative approaches such as crowdsourcing the legwork for far-flung spatial mapping as **Ubiquity6**, **Niantic** and **6D.ai** (see the next section) are doing. Meanwhile, **Google** utilizes visual databases for object recognition while startups like **Sturfee** utilize satellite imagery.

Crowdsourcing is advantageous in that it has the potential for scale. But the downside is that it relies on users to participate in an activity that may not be familiar. Panning your phone around to scan physical spaces is a deliberate behavior that has to be conditioned. It's not culturally a thing yet.

6D.ai is tackling this in interesting ways with SDKs for developers who utilize its spatial mapping in return for sharing back data that their user's capture, a la **Waze**. Apps like **BabbleRabbit** have, in turn, found creative ways to get users to pan their phones around a space in gamified ways.

Ubiquity6 likewise leans towards the crowdsourced end of the spectrum in the ways explored above, including empowering users with artistic expression and ownership of digital spaces. To accelerate this user behavior, it recently launched **Display.land**, a free tool to get 3D scans of one's space.

This doesn't involve AR, and is simply a free tool to create 3D digital models of your physical space. This is an interesting approach in that **Ubiquity6** is essentially conditioning the user behavior it needs from users – capturing

spatial maps of their spaces – by incentivizing it with a free tool.

The incentive here is access to erstwhile-inaccessible and potentially-powerful functions. For example, there's no easier way today to create and share a free 3D scan of one's space using a smartphone You could technically use this for 3D apartment scans for **Craigslist** or **Airbnb**, or share it with friends.

Display.land also introduces a new behavior that piggybacks on users' conceptual understanding of an old one. In other words, one of today's most popular mobile activities is capturing photos and videos, then sharing to a social graph. **Dislplay.land**, taps into that sense of familiarity.

The second step came with **Display.land's** follow-on Studio feature. This is where AR comes in, allowing users to fill their scans with graphics in a drag & drop way. Those graphics then appear in the corresponding real-world locations as AR overlays when viewed through **Ubiquity6's** Reality Browser.

The results so far include **92,000** 3D scans already created by users. More use cases will develop organically over time, and we'll see if this achieves the intended purpose of acclimating users towards the somewhat unnatural act of scanning physical spaces, thereby accelerating the AR cloud.
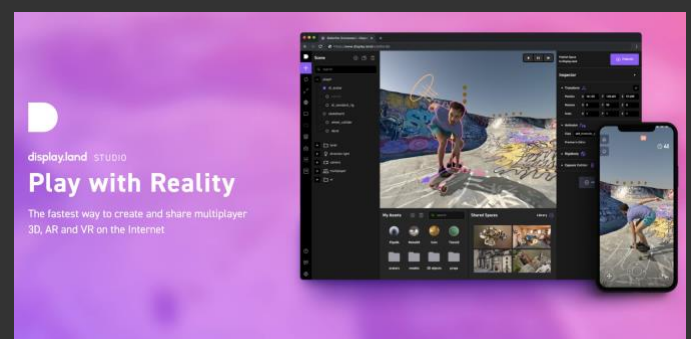

Image Source: Ubiquity6

6D.AI

In our ongoing coverage of the AR cloud, one question keeps popping up: who will build it? The answer is that no one entity will do so (and there won't just be one "cloud"), but several specialized toolsets will contribute to the AR cloud's assembly and maintenance.

As mentioned in the previous section, one of those toolsets is 6D.ai. Bringing pedigree, validation and top IP to the table, it's a front runner for potential impact and value creation among AR cloud startups. Its advantage also includes the perspective and AR tenure of co-founder & CEO Matt Miesnieks.

"The high-level objective is to make AR apps engaging beyond novelty," he told us. "Among all the challenges, the one that personally appealed to me was the computer vision (CV) pieces that need to be built. And then how are those exposed to developers?"

The result is 6D.ai, which packages novel CV and scene mapping technology into an API. By handing that over to developers, it scales up the ability to build a spatial map of the world. In other words, users of 6D-powered apps can actively or passively map the world while experiencing AR.

"You start to get a data network effect where every app that uses a 6D.ai-powered app in a physical space contributes to making the description of that physical space more comprehensive," said Miesnieks, "which means that the next person that comes along gets a rock-solid experience."

This value exchange is core to 6D's go-to-market strategy. By benefiting from AR cloud data, users are motivated to collect data. Further incentive can lie in game perks or performance. Think of it like Foursquare leader boards or, better yet, Waze's incentivized data collection by users.

"There's a way to build-in intrinsic rewards," said Miesnieks. "There are status boards and leader boards, and maybe you unlock extra levels or capabilities into an app. That can be very powerful to get people to go and scan places they might not otherwise have gone."

Chicken & Egg

6D.ai also addresses a chicken and egg dilemma: Developers won't build AR apps without an AR cloud in place. And the AR cloud won't be built without apps to assemble the 3D mapping data. **6D.ai** crowdsources the mesh construction via API. This approach invokes **Charlie Fink's** Convergence.*xiv*

"Charlie talks about 'painting the world with data'," said Miesnieks. "Before you can paint the world with data, you need a digital model of the world to paint on. Up to now, getting that model has always been a chicken-and-egg [challenge] for any application developer."

The other challenge according to Miesnieks is that realistic and positionally-accurate AR has been possible for years… but mostly with marker-based AR. As a practical note, the hard part is gaining that same level of functionality with moving objects and real-world conditions where it "just works."

"If you're willing to ask a consumer to print a piece of paper and put it on the ground with a marker on it, you could get a good AR experience," said Miesnieks. "Today's

challenge for multiplayer, persistence and occlusion is how do you get it to be something that just works for *everybody*."

To accomplish this, the ultimate shift will happen on more deeply structural levels. This traces back to the evolution of computing. We've had operating systems that have common APIs that developers call to access the hardware. Then, some of that functionality was moved to the cloud, a la **AWS**.

But the next step in that evolution could be a sort of cloud-based operating system for the real world. This would distribute a spatial understanding of the physical world. That's 3-D mesh data, but also deeper contextual understanding of the people, objects and motions of the physical world.

"A real-world operating system is going to be the platform that we believe will be ultimately the most valuable asset." Miesnieks said. "It's a platform transition similar to **Google's** search index or **Facebook's** social graphs — a hugely important topic that's going to affect our lives."
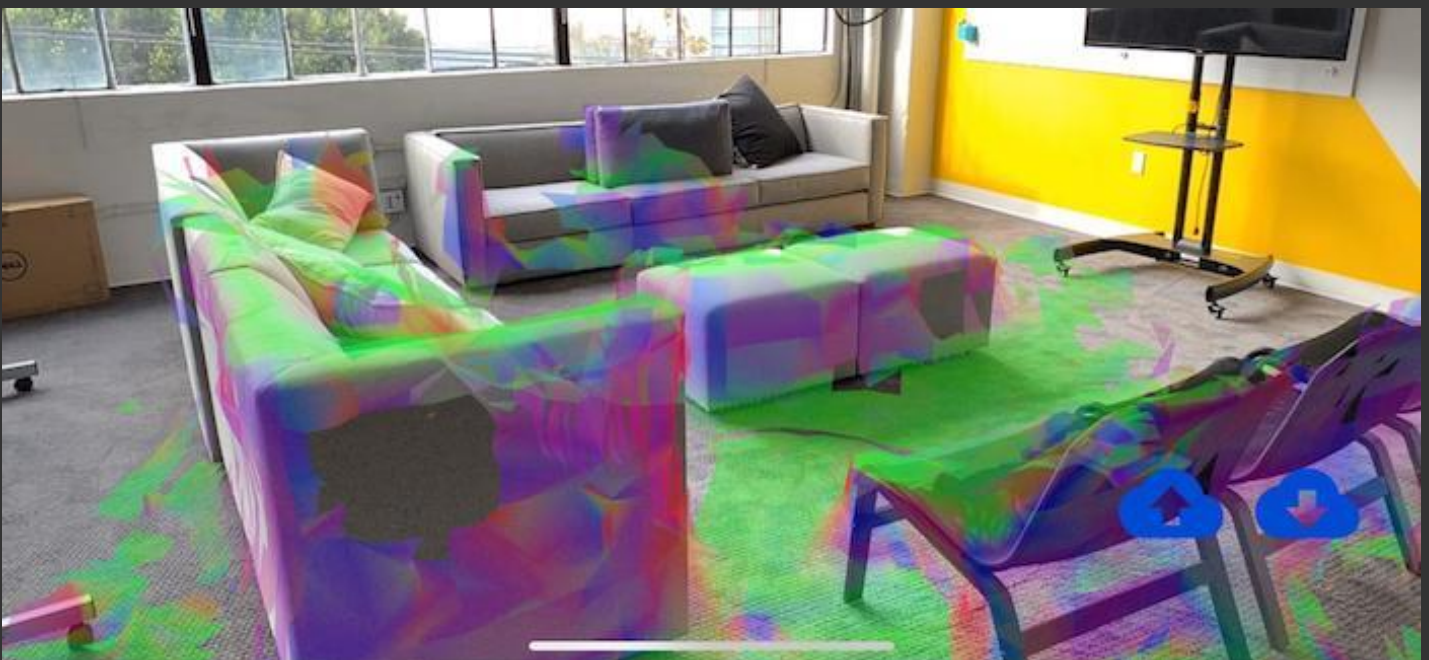
AR Hopefuls

As the final category of AR's emerging class of potential leaders, we'll examine a few companies to only recently enter the market. One is a hardware gaming company with a fresh take on AR product strategies. **Tilt Five** brings technical chops and lots of early demand signals to AR-based gaming.

The other follows in the footsteps of Pokémon Go. **Minecraft Earth** replicates those success factors including location-relevant migratory play and compelling game mechanics. More importantly, it's all wrapped around world-renowned IP that's popular among younger generations. Will it be enough?
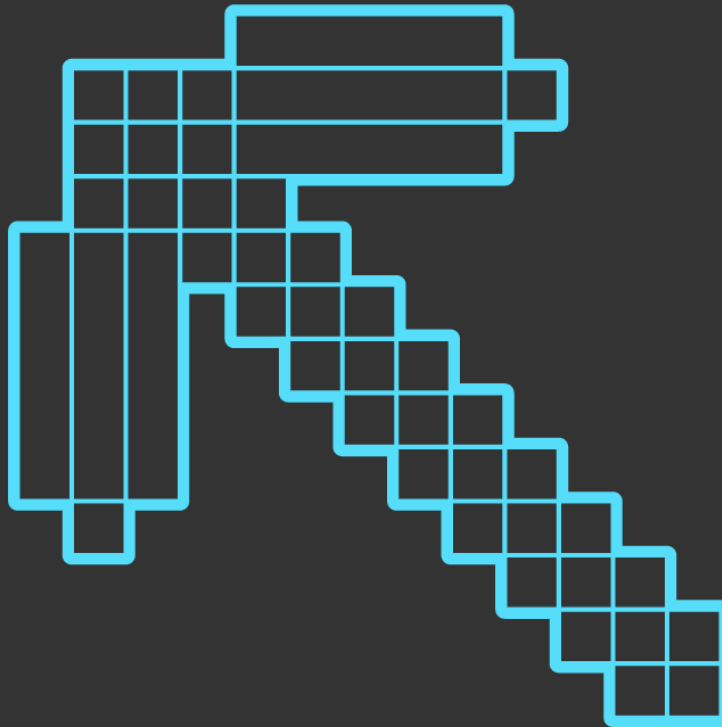
Tilt Five

An AR industry rally cry over the past few years has been the concept of "AR everywhere." That principle embodies the AR cloud, explored in the previous few sections. But when talking about the practicality of AR today, should it be less *everywhere* and more about AR *somewhere*?

This is a core principle behind **Tilt Five**. Its Kickstarter-backed AR gameboard works in tandem with glasses and a wand. It also serves as an open platform for developers and game partners to build AR games that are stationary but high-quality and user-friendly.

"I love the systems that are 'AR anywhere.' Those are really cool but they have limitations… We decided to do AR somewhere," said the always-insightful **Tilt Five** CEO Jeri Ellsworth on a recent episode of the tech reviews show Projections. "We can just nail that and make it perfect."

AR glasses often involve a tradeoff between several specs that are key considerations for "anywhere" operability, such as bulk versus performance. **Tilt Five**'s stationary approach conversely engenders design leeway to sidestep some of these common challenges.

"The system is super lightweight, it's just **85 grams**. It just folds up and slip it on," said Ellsworth. "Our main objective is to have a system where you fold the game board out, slip the glasses on, and just get right into the fun… No calibrations, no complicated setup, no sensors in the room.

Of course, to achieve that level of user-friendliness and hardware efficiency is more complicated. **Tilt Five's** proprietary technology utilizes a retro-reflective gameboard which works with onboard glasses optics to achieve realistic AR interactions and depth.

This is what really makes it "AR somewhere" because AR glasses otherwise can't practically utilize customized surfaces out in the world, per Matt Miesniek's comment earlier. But purpose-built for a stationary experience, **Tilt Five** was able to solve common AR challenges.

"So our system is kind of unique compared to others," said Ellsworth on the same Projections episode. "[It] actually projects out to a special game board which is called a retroreflector and that allows us to make the headset really high-performance, lightweight, and super-wide field-of-view.

Tilt Five's go-to-market strategy is also importantly built on a platform approach that invites developers to build experiences. This will be key to populating the experience with a range of games that tap into developer creativity. We'll see everything from card games to tower defense to RPGs.

"Many of them will be on PC and **Android**," said Ellsworth. Just go to **Google Play** or **Steam**, download the game and you're good to

go… We have a bunch of games that are going to ship with the system which are kind of party action games [...] Then we have some solo play experiences."

Dungeons and Dragons-type games will also be fitting. In fact, **Tilt Five** has partnered with IP holding company **Fantasy Grounds** to port its licensed titles, which represents a key partnering aspect of its go-to-market strategy, in addition to open community development.

Importantly, the **Fantasy Grounds** partnership brings in an existing and avid user base. It will also operate across platforms so **Tilt Five** users can play with non-**Tilt Five** users. This is smart to allay compatibility barriers, while also exposing **Tilt Five** to potential converts on other systems.

As for a launch timeline, the project completed its **Kickstarter**, quadrupling its set goal and raising almost **$1.8 million**. Its plan was to distribute hardware to the first backers in Q1 2020, but manufacturing has been slowed down by the global Coronavirus outbreak. As these challenges abate, we expect big things.

Click to Play

Boiling it Down

Boiling **Tilt Five's** story down to a few discernable lessons, the first thing that sticks out is product focus. Instead of going after too many markets. **Tilt Five's** strategy is and has been to zero in on nailing a specific experience. And that starts with socially-oriented tabletop gaming.

"In the hype cycle around AR, I think too many people expect one singular product that does a bazillion things," Ellsworth said at a Samsung NEXT meetup. "It has my location in real time, 3D maps, it understands every object in the scene, voice recognition and AI…This is too much. Technology never launches that way."

Tilt Five has likewise deviated from lots of companies selling AR and VR hardware by focusing on the user experience rather than tech specs. Eschewing the common specs

arms race in this way is one of the factors we attribute to the success of **Tilt Five's** Kickstarter campaign mentioned above.

The strategy is also to make the product approachable by meeting users halfway with AR integrations that enhance something that's already familiar – In this case a board game format. This is the "training wheels," concept that keeps coming up in the pages of this report and three-part series.

"We take for granted that one day we woke up and there was this really great phone in our pocket, but there was a lot of evolution along the way," Ellsworth said at the aforementioned meetup. "In AR and VR, we're going to do those same things, and our user interfaces are going to be constantly changing."

Minecraft Earth

One of the most hotly-anticipated AR apps of the past year is **Minecraft Earth**. Utilizing proven location-based game mechanics of Pokémon Go, along with strong IP and backers (including **Microsoft**), several factors align to designate it as an *AR hopeful*.

And it's come out of the gates strong. Sensor Tower reports that it racked up **1.2 million** downloads and **$93,000** in in-app purchases in its first week. This puts in third place in first-week downloads for AR games, behind **Pokémon Go** and **Harry Potter, Wizards Unite**.

It should be noted however when evaluating these first-week rankings that **Minecraft Earth** hasn't launched in all geographies yet. It's availability so far includes the U.S. (**86.2 percent** of downloads), Great Britain (**5 percent**) and Canada (**2.6 percent**).

As background, the **Minecraft** IP is owned by Microsoft and the game is released by **Mojang** – sort of like the relationship between **Nintendo** and **Niantic**. In this case, the IP owner **Microsoft** has also contributed to the tech stack with its Spatial Anchors AR cloud technology among other things.

Speaking of IP, this is a big success factor for location-based AR games. Because AR isn't proven enough as a consumer technology, success stories have been buttressed by strong brands that attract existing fans. That goes for **Pokémon Go** and **Harry Potter, Wizards Unite**.

Minecraft Earth checks that box but it's only half the battle. Game mechanics and design must back up the IP with compelling play. As we examined in Part II of this report series, **Pokémon Go** has sustained usage over time

(rare for mobile gaming) with updates and inherent replayability.

Another success factor is not relying too heavily on AR as a central game component. **Pokémon Go** for example, uses AR in sparing and additive ways. AR mode is used **2-3 minutes** per session, and its GO Snapshot feature lets players take and share photos with captured Pokémon.

Another factor is how well the game mechanics, AR components and location-based dynamics meld with the IP. These things dovetail nicely with **Pokémon Go** in that the franchise theme is naturally aligned with physical-world voyages to capture monsters.

It's been argued that **Harry Potter, Wizards Unite** isn't as conducive to the game design inherited from **Pokémon Go**, and feels less natural. It's trailing behind **Pokémon Go** in downloads and revenue, but it should get some credit for being a strong title in its own right.

This is all to say that **Minecraft Earth** has the ingredients for success in its strong IP and early engagement. Whether or not that's sustainable will come down to the above execution factors. It seems to check a lot of those boxes based on early evidence, but more time is needed.
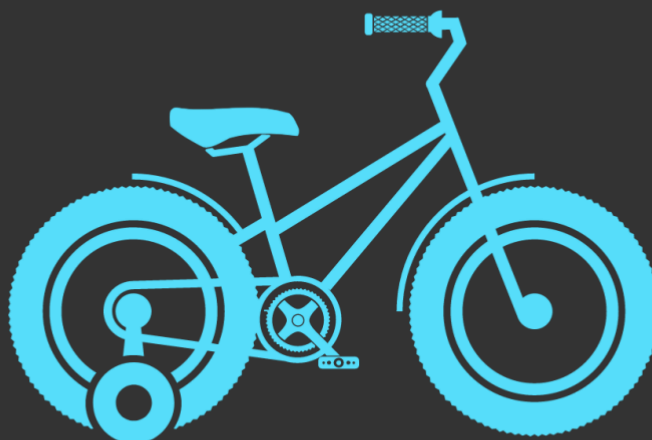

Image Source: Mojang

Final Thoughts: Training Wheels

One common theme has come up in this report and throughout the entire 3-part series: The principle of AR *training wheels*. This is important in AR's early stages of consumer adoption when it isn't yet proven enough to compel users to go out of their way. So it's all about meeting them where they already are.

This can be seen in **Instagram** and **Houzz'** AR commerce integrations. It can be seen in **Snapchat's** AR integration in natural ways to the already-prevalent activity of sharing media socially. And it can be seen in **Pokémon Go's** sparing use of AR as a compelling game element... but not the main dish.

The prevalence of this theme throughout AR's early success stories means that it should be a design target for any AR startups. Beyond startups, it should also be considered for any non-AR companies entering the fray, such as brands that are exploring ways that AR can help engage their customers.

Eventually, AR will be popular and prevalent enough to stand on its own (or 'ride on its own' to stay true to the training wheels metaphor). Until then, it's all about slow progression. That should happen on both micro levels of product design... as well as macro levels of business strategy.

▌▌▌ Key Takeaways

▌AR During consumer AR's early stages, success stories are scarce but critical for extractable lessons.
▌AR This includes product models (UX design) and business models (when/how/whom to charge).
▌AR Though enterprise/industrial AR is important, this analysis focuses on consumer-based AR.
▌AR Together with Parts I & II of this report series, several patterns and transferrable lessons are evident.
▌AR Consumer AR success factors will be a moving target but are starting to standardize into best practices.

▌AR After examining revenue leaders in Parts I & II, we'll turn attention to promising emerging players.
▌AR This includes AR *converts*, *enablers* and *hopefuls*, segmenting the market into a few key areas.
▌AR AR *Converts* are established companies that are now moving into AR, such as Instagram.
▌AR AR *Enablers* are the "picks & shovels" tool providers who are accelerating AR's advancement.
▌AR AR *Hopefuls* are players to only recently enter the market, worth watching for their early demand signals.

▌AR Starting with AR *converts*, deep-pocketed companies entering AR are advantaged by resources & networks.
▌AR However, these factors don't guarantee success which relies on execution and following best practices.
▌AR Among AR converts – Instagram, Houzz and Pinterest – one common thread is AR's point of integration.
▌AR Each of these players has integrated AR in ways that align with users' existing comfort and cognition.
▌AR Similar to Snapchat and Pokémon Go, this applies AR sparingly as an additive element... not a main course.

▌AR For AR *enablers*, the name of the game is to democratize advanced AR creation.
▌AR 8th Wall espouses web AR's ability to democratize AR access. It applies the same approach to developers.
▌AR Ubiquity6 likewise supports web AR and brings tools to people who want to build and own virtual spaces.
▌AR 6D.ai takes a crowdsourced approach to incentivize spatial mapping creation through a value exchange.

▌AR For AR *hopefuls*, there's a combination of fresh thinking and following proven methods in AR's short lifespan.
▌AR Tilt Five eschews the popular concept of *AR everywhere*, in favor of perfecting *AR somewhere.*
▌AR Its focus on doing one thing well, and straightforward marketing, resulted in **$1.7M** in Kickstarter backing.
▌AR Like some of the above examples, Tilt Five applies AR to an existing and familiar activity (board games).

▌AR One key commonality in these businesses (and those in Parts I & II) is the principle of AR *training wheels*.
▌AR AR is too early and unproven to get consumers to "work for it" or go out of their way to activate it.
▌AR The most successful forms of AR have conversely applied it as an organic and value-added component.
▌AR AR will eventually stand on its own, including "native" design, but at this stage needs to build on the *familiar.*

▌AR The training wheels concept will be examined in a future standalone report with more case studies.
▌AR Meanwhile, the companies in this report have transferrable lessons that we'll continue to observe and report.

![ARtillery Intelligence logo]

About ARtillery Intelligence

ARtillery Intelligence chronicles the evolution of spatial computing. Through writings and multimedia, it provides deep and analytical views into the industry's biggest players, opportunities and strategies.

Run by analysts and former journalists, coverage is grounded in a disciplined and journalistic approach. It also maintains a business angle: Though there are lots of fun and games in spatial computing, cultural, technological and financial implications are the primary focus.

Products include the AR Insider publication and the ARtillery PRO research subscription, which together engender a circular flow of knowledge. Research includes monthly narrative reports, market-sizing forecasts consumer survey data and multi-media, all housed in a robust intelligence vault.

Learn more here.

About Intelligence Briefings

ARtillery Intelligence Briefings are monthly installments of spatial computing analysis. They synthesize original and third-party data to reveal opportunities and dynamics of VR and AR sectors. 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 **here.**

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* and Editor-in-Chief of *AR Insider.*

Mike is a frequent speaker at industry conferences such as AWE, VRLA and XRDC. He has authored more than 120 reports and market-sizing forecasts on the tech & media landscape. He contributes regularly to 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 read **here.**

Methodology

This report highlights *ARtillery Intelligence* viewpoints, gathered from its daily in-depth coverage of spatial computing. To support narratives, 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 market sizing and forecasting, *ARtillery Intelligence* follows disciplined best practices, developed and reinforced through its principles' 15 years in tech-sector research and intelligence. This includes the past 4 years covering AR & VR exclusively, as seen in research reports and daily reporting.

Furthermore, devising these figures involves the "bottom-up" market-sizing methodology, which involves granular revenue dynamics such as unit penetration, pricing and growth patterns. More on ARtillery Intelligence market-sizing research and methodologies can be read **here.**

Disclosure and Ethics Policy

ARtillery Intelligence has no financial stake in the companies mentioned in this report, nor was it commissioned to produce it. With respect to market sizing, *ARtillery Intelligence* remains independent of players and practitioners in the sectors it covers, thus mitigating bias in industry revenue calculations and projections.

ARtillery Intelligence's disclosure and ethics policy can be seen in full **here.**

Contact

Questions and requests for deeper analysis can be submitted **here.**

References

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i See ARtillery Intelligence Report: Industrial AR Benefits and Barriers (sign-in required)

ii See ARtillery Intelligence Report: AR: The Top of the Food Chain, Part I & Part II (sign-in required)

iii See AR Insider Article: Is Facebook Building a Social Layer for the Spatial Web

iv See ARtillery Intelligence Report: AR Cloud and the Internet of Places (sign-in required)

v See ARtillery Intelligence Data Brief: Facebook Boosts Purchases 28% with AR

vi See ARtillery Intelligence Data Brief: AR Boosts Consumer Purchases

vii See ARtillery Intelligence Report: 2018 Lessons, 2019 Outlook (sign-in required)

viii See ARtillery Intelligence Report: AR: The Top of the Food Chain, Part I & Part II (sign-in required)

ix See ARtillery Intelligence Data Brief: Pinterest Lens Recognizes 2.5B Objects (sign-in required)

x See ARtillery Intelligence Report: AR: The Top of the Food Chain, Part I & Part II (sign-in required)

xi See ARtillery Intelligence Report: Mobile AR Strategies & Business Models (sign-in required)

xii See ARtillery Intelligence Report: Global AR Revenue Forecast, 2018-2023 (sign-in required)

xiii See ARtillery Intelligence Report: Mobile AR Strategies & Business Models (sign-in required)

xiv See AR Insider Article: Fink's Convergence Connects the Dots on an Augmented Future