

AUGUST 2019

# AR/VR Innovation Report

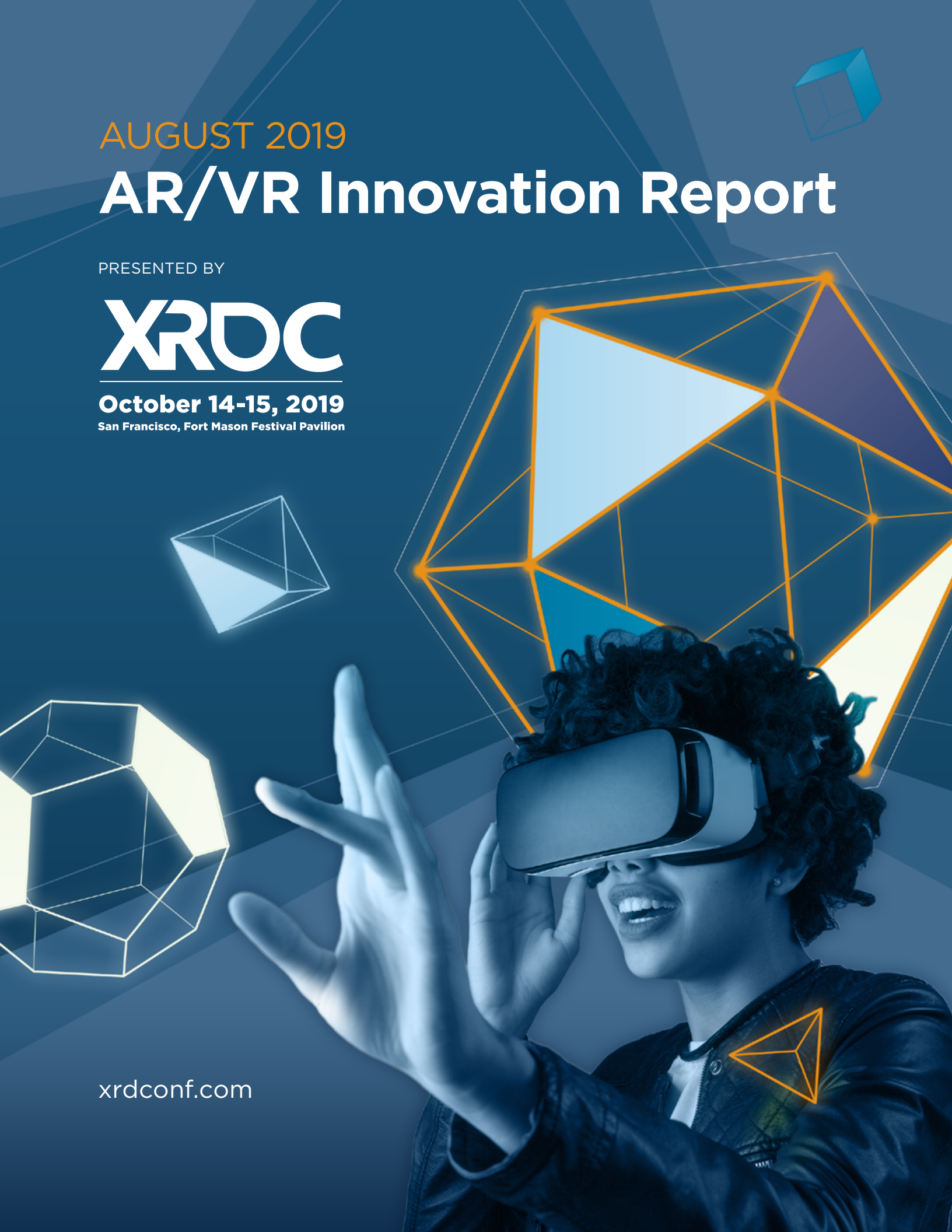
PRESENTED BY

# XRDC

**October 14-15, 2019**

San Francisco, Fort Mason Festival Pavilion

[xrdconf.com](http://xrdconf.com)





## AR/VR Innovation Report

### August 2019

**W**elcome to the fourth annual XRDC AR/VR Innovation Report. This industry-leading report has been compiled based on data gathered from surveying over 900 professionals involved in the development of augmented, virtual, and mixed reality experiences.

The data and insights contained within are intended to provide useful perspective on this rapidly expanding and diversifying industry. Notable findings from this year's research include the return of the Oculus Rift as devs' top platform, a rising tide of client funding, and growing excitement about the potential of the Oculus Quest to bring a wave of people into VR.

Survey respondents also recommended some of their favorite AR/VR/MR experiences, including classics like Beat Saber and The Void as well as the recently-released Magic Leap One headset.

This data was collected, organized, and presented by Informa Tech, which organizes and runs XRDC as well as the Game Developers Conference (GDC) and Gamasutra.com.

XRDC will take place October 14-15, 2019 at the Fort Mason Festival Pavilion in San Francisco, a beautiful new waterfront venue well-suited to AR/VR demos, discussions, and networking.

Creators of immersive experiences of all kinds—including groundbreaking work in AR & VR for games, entertainment, education, healthcare, medicine, training, automotive, sports, UX, data visualization, brand experience, and more—will be there to learn and share knowledge in a convivial atmosphere.

## GAMES REMAIN THE TOP FOCUS FOR AR/VR/MR DEVELOPMENT

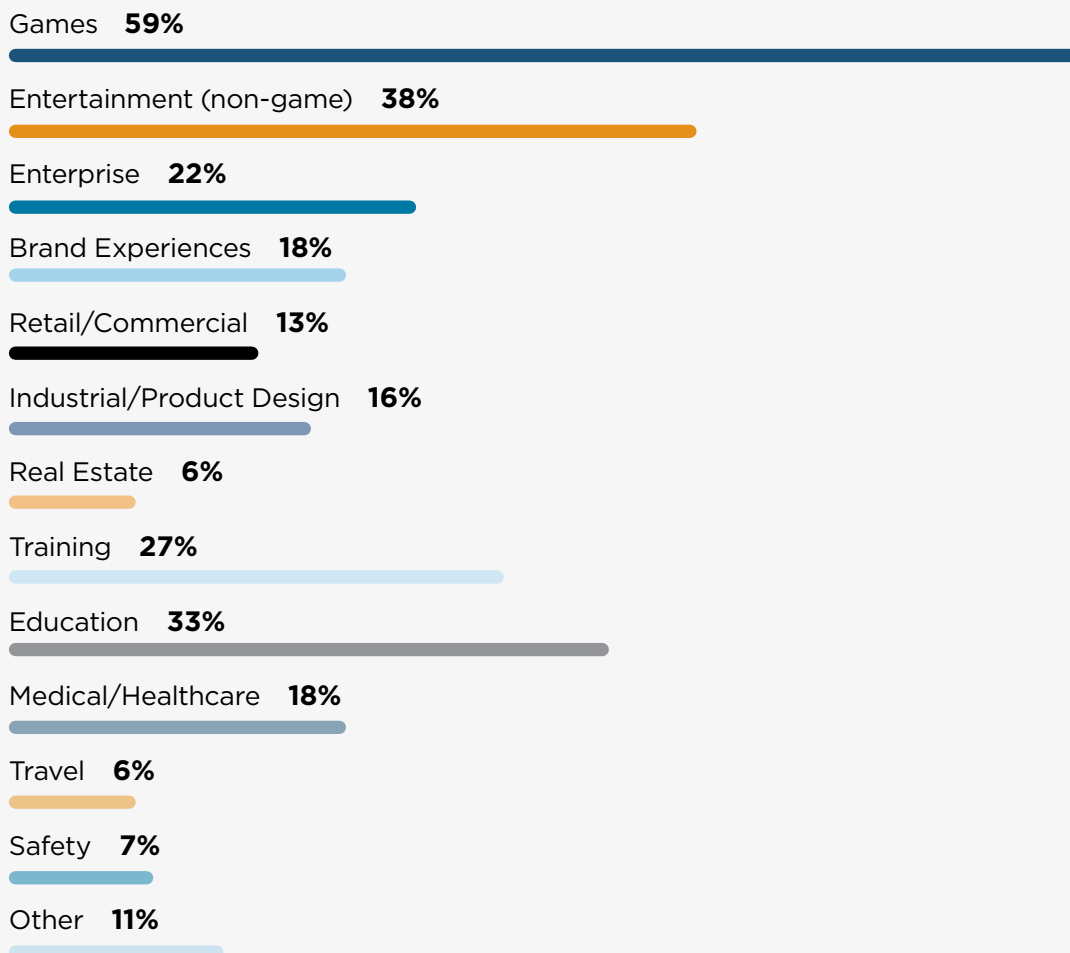
The first step to figuring out where AR/VR/MR devs are at this year is to find out what they're working on, so we asked our survey respondents to tell us the focus(es) of their current or potential work in the field.

As in years past, the most popular answer was Games, with 59 percent of respondents saying that's what they're focused on right now. Entertainment (other than games) was the second most popular focus, netting 38 percent of respondents, while 33 percent said they're focused on Education projects.

This is a bit more granular than last year, when we grouped some of the possible answers together and thus found 70 percent of devs were focused on Games/Entertainment, 37 percent were working on Training/Education projects, and Branded Experiences were a focus for 25 percent of respondents.

By expanding the pool of potential answers, we're able to see that games truly are the driving focus for AR/VR/MR development.

### What is the focus of your current/potential work in AR/VR/MR?





## OCULUS RIFT SURPASSES THE HTC VIVE AS DEVS' TOP AR/VR/MR PLATFORM, AND THE OCULUS QUEST IS ALREADY GENERATING BIG INTEREST

When we asked survey respondents which AR/VR/MR platform(s) they're currently developing for, 29 percent said the Oculus Rift, 24 percent said the Oculus Quest, and 24 percent said the HTC Vive.

This is a big deal: the HTC Vive has been the most popular platform among devs surveyed for the Innovation Report for three years running, but this year it seems like Oculus has managed to recapture some creators' interest.

More notably, the Quest has already secured a foothold among devs' top 3 most popular VR platforms despite only releasing a few months ago. This suggests devs are excited about the Quest's promise of wireless, portable VR with 6DoF (Degrees of Freedom) controllers, and the comparatively low cost of entry (the cheapest model of Quest retails for \$399) probably doesn't hurt either.

We saw a similar split in interest when we checked in with respondents to see what platform(s) their last project was released on, and what platform(s) they're targeting for their next project.

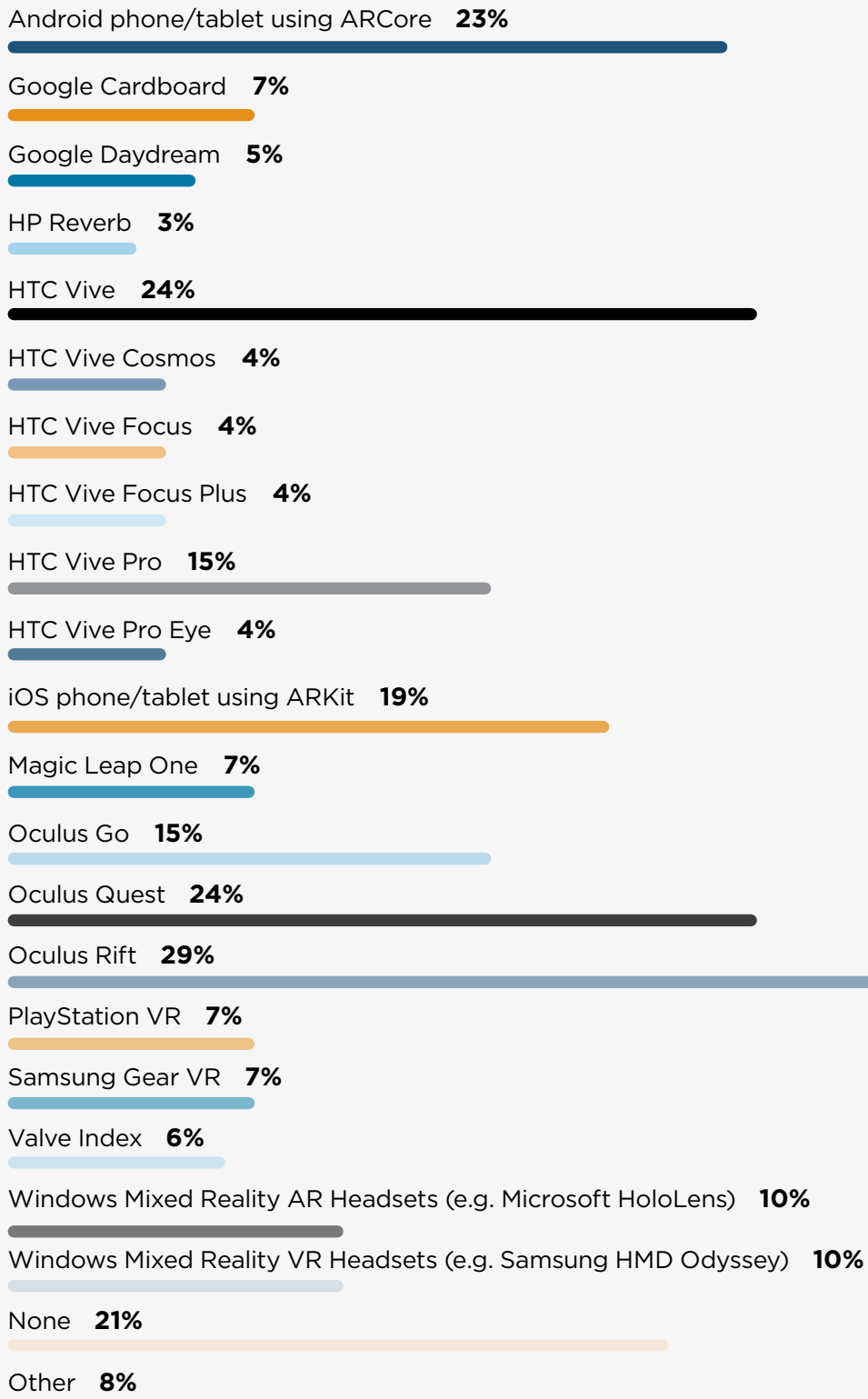
30 percent said their last project came to the Oculus Rift, 29 percent said it landed on the HTC Vive, and 22 percent said their last work came to an Android phone or tablet via ARCore. Intriguingly, 12 percent of those we surveyed said their last project was released on the Oculus Quest, which is somewhat surprising given how recently the platform debuted.

Looking ahead, 30 percent of respondents said their next AR/VR/MR project is going to be released on the Oculus Rift, 28 percent said the Oculus Quest, and 24 percent said the HTC Vive.

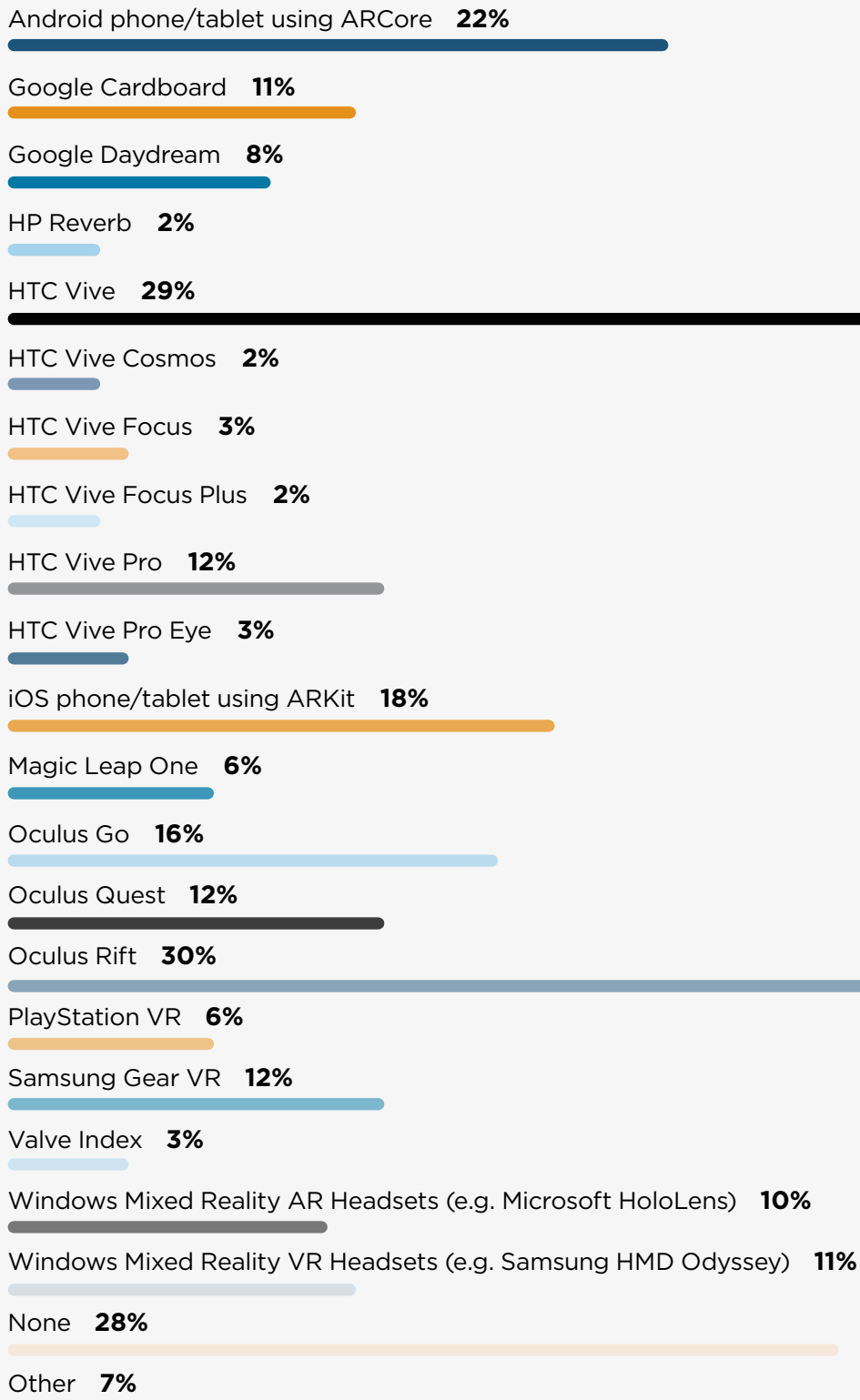


PHOTO COURTESY OF OCULUS

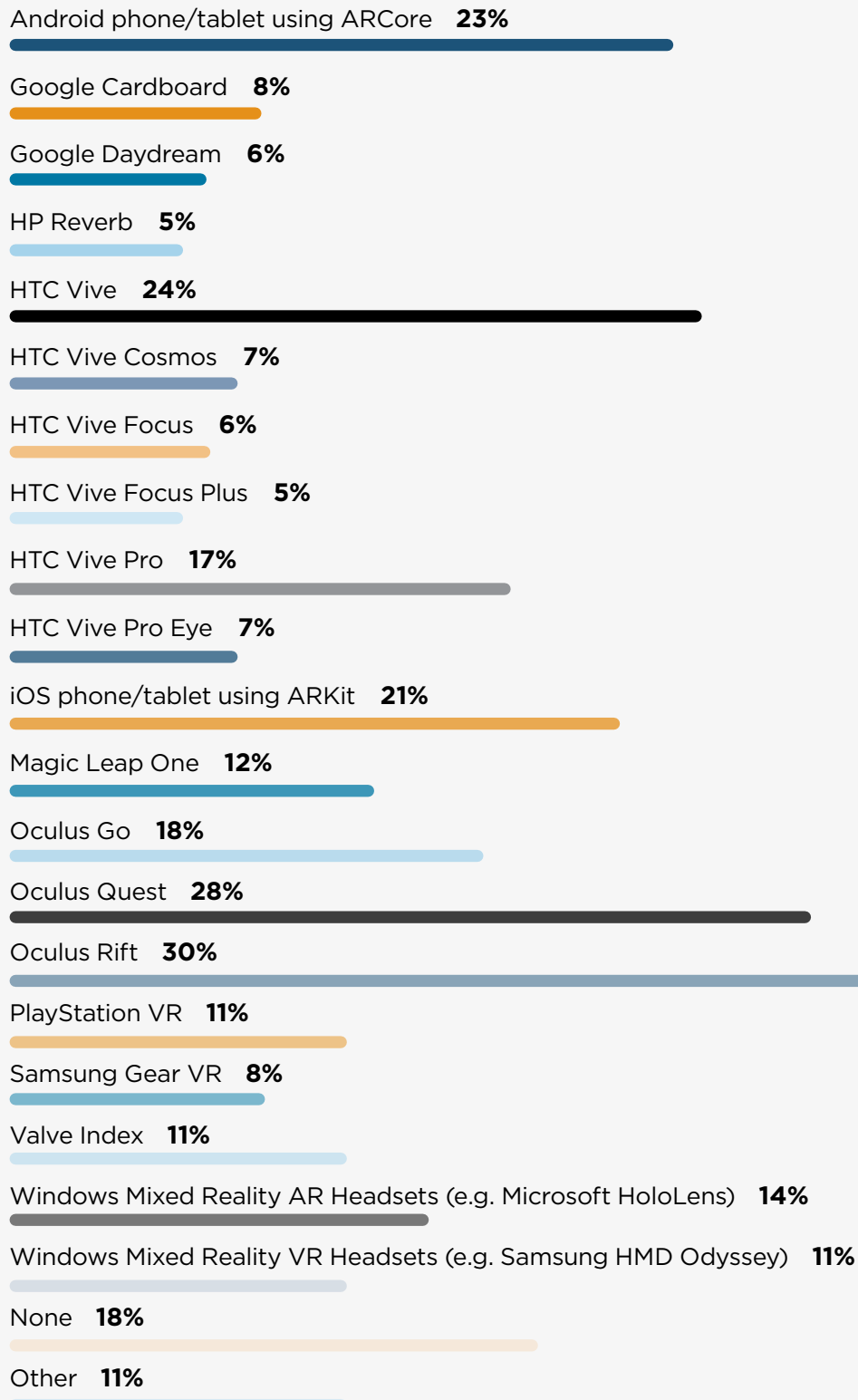
## On which AR/VR/MR platform(s) are you developing your current project?



## On which AR/VR/MR platform(s) was your previous project released?



## On which AR/VR/MR platform(s) will you be developing your next project?

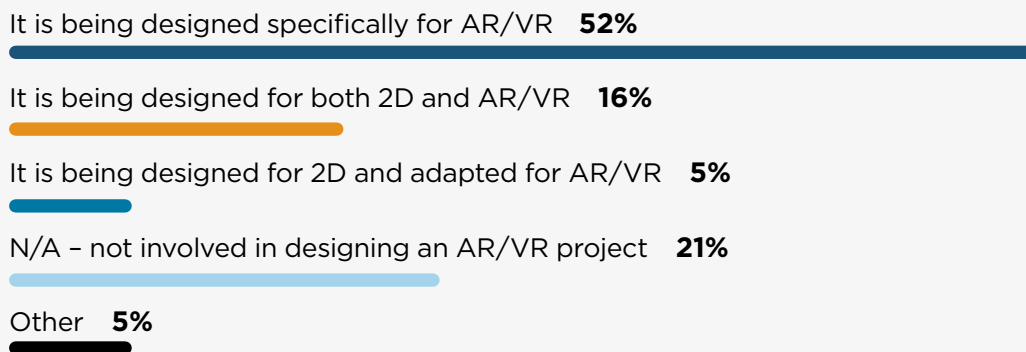




## THE MAJORITY OF AR/VR DEVS AREN'T CONCERNED ABOUT ADAPTING THEIR WORK TO 2D

It's common to see traditional 2D games, entertainment, and utilities adapted to VR, or complemented with AR/VR components. This was especially common at the dawn of modern consumer VR, and to get a sense of where devs are at these days, we asked respondents whether their projects are purely AR/VR, AR/VR with 2D adaptations, or based on established 2D projects.

### Which of the following statements applies to your current AR/VR project?



Notably, the majority (52 percent) said their current project is being designed specifically for AR/VR, suggesting they (or decision-makers they support) believe that the AR/VR market is now large and robust enough to make dedicated AR/VR experiences worthwhile.

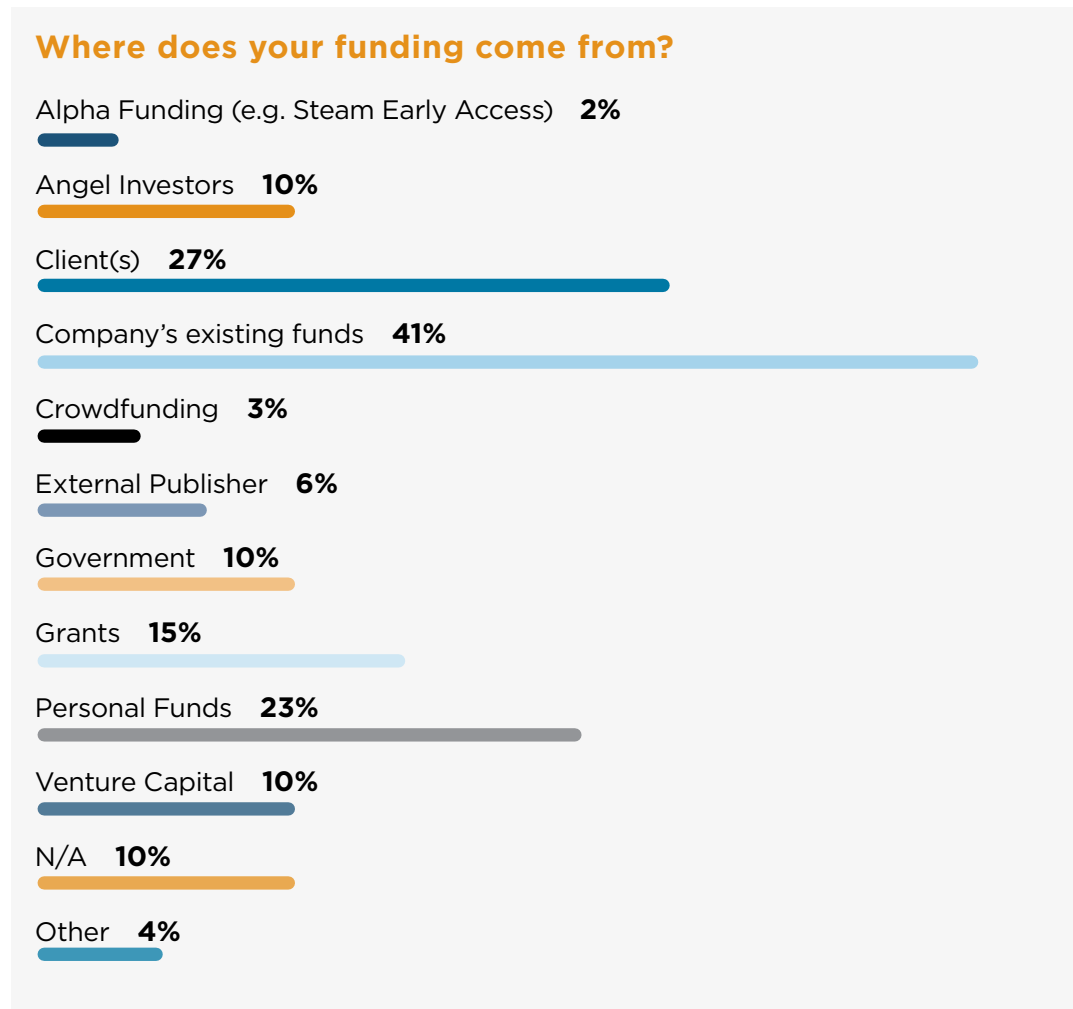
16 percent of respondents said their current project is being developed simultaneously for both AR/VR and 2D, and just 5 percent said they're working on a 2D project that will be adapted to AR/VR.



## MOST AR/VR/MR PROJECTS ARE STILL PAID FOR OUT OF COMPANY COFFERS, BUT CLIENT INVESTMENT IS RISING

To better understand these industries it's critical to know where the money is coming from, so every year we ask our survey respondents how they fund their AR/VR/MR work.

As in years past, the most popular response remains the company's existing funds (41 percent); but this year it seems that investment from clients has crept up to become the second most popular source of AR/VR/MR funding, with 27 percent of respondents saying they're funded by a client or clients.



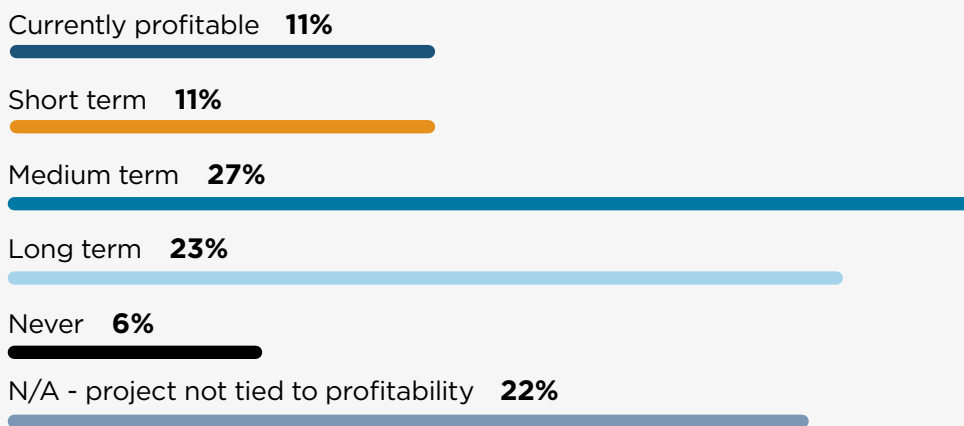
23 percent of respondents said they fund their AR/VR/MR work out of their own personal funds, which is a bit less than the 27 percent who said the same thing last year. Hopefully this means that as the AR/VR/MR markets mature and devs master their craft, more and more clients are stepping up to pay for well-made immersive experiences.

## MOST DEVS STILL AREN'T SEEING SHORT-TERM RETURNS

We also asked our respondents to tell us when they expect their projects will generate a profit for them or their clients, and as in years past, more are expecting medium- and long-term profitability than short-term returns.

This year 27 percent of respondents said they expected medium-term profitability on their AR/VR/MR project(s), while 23 percent expected long-term profitability, and 11 percent expected short-term returns. Only 11 percent said their project(s) were currently profitable, which is lower than the 14 percent who said so last year.

### When do you believe your AR/VR/MR project(s) will generate a profit for you or your client(s)?



In fact, all of these percentages were down year-over-year, in part because the share of respondents who said their AR/VR/MR work isn't tied to profitability shot up, from just 11 percent last year to 22 percent this year.

This could be due to more and more hobbyists entering the AR/VR/MR development space, or it may suggest that more businesses, nonprofits, and government agencies are investing in AR/VR/MR development with aims other than turning a profit. This is backed up by the array of talks on offer at XRDC this year which highlight how AR/VR/MR technologies are being applied to fields like healthcare, public safety, and workplace training.

## DEVS REMAIN CONCERNED ABOUT THE SIZE OF THE VR MARKET AND THE LACK OF FUNDING FOR SMALL- TO MID-SIZE TEAMS

To better understand where they're coming from, we also gave respondents the option of sharing their perspectives on the current state of funding for AR/VR/MR projects. Most seemed to feel that it's better than it has been, but many felt that too much of it is tied up in big VR platform holders like Oculus and Magic Leap.

We also saw continuing concern over the cost of producing great VR being too high relative to the size of the prospective audience. However, the recent success of the Oculus Quest was mentioned multiple times as a reason to hope for a new wave of customers joining the VR market.

"Funding is plentiful, but most of the money gets swallowed up by the largest corporations. Unfortunately, small and medium sized companies are growing by acquisition into larger companies rather than solo development," wrote one respondent. "Small and medium companies shoulder such a large amount of the risks to bring a product to market. It would be great to have some capital or resources to bring visibility to these smaller projects before they are selling off company assets."

*Small and medium companies shoulder such a large amount of the risks to bring a product to market. It would be great to have some capital or resources to bring visibility to these smaller projects before they are selling off company assets.*

"There is a gap between the cost of production and the expected budget for mixed reality projects," wrote another. "There still needs to be a large push to support projects that reduce the costs of development so that more content can be created."

"It's difficult for high-production-value VR to flourish without external funding given the current market size," opined one respondent. "Hopefully that will change as more accessible headsets (e.g. Oculus Quest) broaden said market."

One respondent added that "I think there was a big push and a lot of excitement but now reality is setting in and the real companies and projects are starting to surface. I think investors are being more selective about where to invest. Still a ways to go before we see consistent big winners."

"Location-based AR and MR data will be ubiquitous as soon as the threshold for seeing it in a natural, unobtrusive way is significantly lowered," wrote another. "VR, with its physical threshold of having to immerse oneself and shut oneself out from one's surroundings, is more similar to reading a book. Both are viable mediums, but very different."

"Actually, I think both will do well," explained another. "Originally, I thought AR was a waste of time, but new developers have come with products that show real potential such as the AR Star Wars game. The only difficulty I foresee is the cost associated with the gear that works best. When the cost is reduced, then that will help to open the market to more people and professions."

## MOST DEVS STILL BELIEVE AR/MR WILL EVENTUALLY BE MORE POPULAR THAN VR

We also asked our survey respondents whether they believe AR/VR/MR is a long-term sustainable market, and the vast majority (91 percent) said yes. While still an overwhelming show of support in these industries, that's slightly down from the 95 percent of respondents who said so last year.

When you're choosing how to spend your time, talent, and resources, it's good to know which technologies are most likely to stand the test of time. To get an informed perspective we asked our 900+ respondents whether they think AR/MR or VR will eventually win the greatest share of the market, and just like last year, two-thirds (76 percent) put their faith in AR/MR over VR.

### In the long term, which do you believe will eventually win the greatest market share?

AR/MR **76%**

VR **24%**

## INCONSISTENT SUPPORT, SMALL CUSTOMER BASE, AND RAPID PACE OF CHANGE CITED AMONG DEVS' TOP AR/VR/MR MARKET CHALLENGES

"Since the tech is relatively still in early days the userbase for glasses/headset devices is still small," added another. "At the same time the tech is rapidly changing which is great as it means rapid progress, but that also leads to a lot of constant learning and R&D needed by devs. Phone or tablet based AR has a large theoretical user base, but in return their content and interaction forms are constrained as one constantly has to hold the device in the hands."

"I think since it's such a new and quickly changing market, there's been trouble with predictability," said one respondent. "Since we are working in a new medium we haven't yet established a very solid foundation for what makes an experience compelling while utilizing 6 degrees of freedom."

*The tech is rapidly changing which is great as it means rapid progress, but that also leads to a lot of constant learning and R&D needed by devs.*

“In my part of the market...understanding,” someone else wrote. “A lot of people have misconceptions about XR: that it’s expensive, that it has low distribution, that people don’t like it. There’s been a lot of misinformation, mostly fueled by uninformed media. But also much of it by irresponsible agencies and production companies who made some big, expensive stuff that didn’t reap rewards for the brand. We are recovering from that now, but it’s still a challenge every day.”

## **VR ACCESSIBILITY IS IMPROVING, BUT DEVS ARE STILL CONCERNED ABOUT COMFORT, BATTERY LIFE, AND COMPLEXITY**

To get a sense of what might be the biggest unsolved problems in AR/VR/MR today, we asked our survey respondents to write in and share their thoughts on the issue.

We got a ton of great responses, which you can find laid out in full in the appendix of this report. Some of the most common recurring concerns include “too many friction points” between devs and customers; while new hardware like the Oculus Quest seems to be making some devs optimistic about a new wave of VR customers hitting the market, many still want to see hardware and software improve to the point that AR/VR/MR technology seamlessly fits into daily life.

“I think the biggest hurdle to VR has been long setup times with cubes, computer configurations, and so on,” wrote in one survey-taker. “There have been recent advances in this area though that address those concerns. Headsets like the Quest hit all the checkboxes to make wide spread VR deployment realistic.”

Another respondent felt that the biggest unsolved problems in AR/VR/MR are “comfort, battery life, and then quality--in that order. And comfort means more than just ‘feels good on the head for three hours at a time’—it means that I’m comfortable wearing it on the subway, at work, while socializing, etc.”

“There are too many tool options that all have flaws and don’t consistently work together,” someone else wrote. “Everyone needs to get on the same page. It’s still the Wild West out there. Remember the HD DVD vs. Blu-ray battle? And that just had two options.”

*I think the biggest hurdle to VR has been long setup times...there have been recent advances in this area though that address those concerns. Headsets like the Quest hit all the checkboxes to make wide spread VR deployment realistic.*



“Getting a desktop experience in a truly portable, non-clunky, standalone/wireless solution is part of the key to success,” said one respondent, adding that it’s “critical to grow the market that will fund the creation of experiences. Mass market will not buy into a clunky thing or a thing that has to be wired up the right way with support devices on tripods or wherever. Gotta have great all-in-one systems that do not need external transmitters or receivers or cameras to track motion through space. All-in-one is where it needs to be.”

## DEVS ARE EXCITED ABOUT THE PACE OF PROGRESS IN AR/VR/MR TECH AND THE EXPANSION OF THE VR MARKET

So what are AR/VR/MR professionals most excited about? We asked our respondents to tell us about what they’re most looking forward to in the AR/VR/MR market over the next 12 months, and the answers were remarkable.

We saw a lot of passion for the expansion of the VR market, and a lot of hope that AR/VR/MR technologies and experiences will continue to advance at a rapid clip.

More than one respondent specifically mentioned the debut of the Oculus Quest; one wrote that they were most excited about “the Quest’s market penetration” because “if this is successful enough it will jumpstart the market, even though content isn’t very mature.

*The technology is in a place where developers are able to push the envelope pretty consistently, so I think we are going to see some really great advancement. I hope to see and possibly make some good use cases in the art world. I think the tech lends itself perfectly for that medium and have yet to see anything close to what it could be.*

“The development in the software ecosystem for PC-based VR, and advancements in display technologies,” is what another respondent is excited about. “Light field technology is only a few years away from becoming successfully miniaturized, so watching how these markets will work to innovate on their current displays will be entertaining as the SDE [“screen door effect”] has been almost eliminated from several display-based HMDs already through entertaining solutions (foveated rendering with eye tracking, or sub-pixel “cramming” have been surprising).”

Someone else wrote that they’re most passionate about “the evolution of experiential design and using AR/VR/MR as needed as part of a larger library of tools including the use of depth sensors, LED screens, interactive projection maps, etc. “

“Really just seeing what people come up with,” wrote another. “The technology is in a place where developers are able to push the envelope pretty consistently, so I think we are going to see some really great advancement. I hope to see and possibly make some good use cases in the art world. I think the tech lends itself perfectly for that medium and have yet to see anything close to what it could be.”

## DEVS ARE EXCITED ABOUT THE PACE OF PROGRESS IN AR/VR/MR TECH AND THE EXPANSION OF THE VR MARKET

To close out, we like to give survey respondents room to highlight specific AR/VR/MR experiences they see as standout examples of what can be accomplished in the medium.

When we asked them to tell us what (if any) projects have made the best use of AR/VR/MR over the last year, many of them said Beat Games' 2018 rhythm game Beat Saber. This is a remarkable show of support for the game, which was also mentioned by name by many respondents of last year's survey as a standout example of VR done right.

"Beat Saber was able to create an extremely sticky game using simple mechanics," wrote one respondent. "The use of your whole body during a VR experience is the best way to feel truly immersed, and they executed that excellently."

Multiple respondents also recommended the Magic Leap One headset, though their praise was tempered with concerns about its future.

"Magic Leap leads the field in AR but falls short in MR," wrote one respondent. "The headset is the greatest obstacle to market expansion."

"In general, medical device industry and industry-level safety and training," added another respondent. "The current state of hardware that we're using isn't hampering how we want to deliver the experience to the user.

A surgeon wants to see an organ system in 3D above the table; they can do that with a device like the HoloLens. The FOV does not have to be large, because that surgeon is ONLY ever looking at an area ~2-3 inches across."

"AR surgery at Imperial College London at St Mary's Hospital," wrote someone else. "It demonstrates early benefits of the technology to people's lives."

"Location-based VR by The Void is still one of the best immersive experiences out there in terms of entertainment," said another respondent. "But many presentations were made at SIGGRAPH Asia showcasing the data visualization potential (especially medical and AEC architecture, engineering, and construction) which I think is very important."

*Beat Saber was able to create an extremely sticky game using simple mechanics. The use of your whole body during a VR experience is the best way to feel truly immersed, and they executed that excellently.*



# The Premier AR, VR & MR Innovation Conference

# XRDC

**October 14-15, 2019**

San Francisco, Fort Mason Festival Pavilion

- Healthcare   ■ Safety & Training
- Games & Entertainment   ■ Branding
- Enterprise Applications

**Register by August 21  
to save \$400**

[xrdconf.com](http://xrdconf.com)



# Appendix: Literal Answers

## ***What are your thoughts on the current state of funding for AR/VR/MR projects?***

---

- » As a medium in its infancy, with limited understanding / familiarity by the general public, it can be difficult to prove the value and potential ROI on VR / AR applications to corporate clients who may not understand. This ends up resulting in lots of prototyping costs to prove out a concept.
- » As a student, I don't see a lot of funding that supports students to create AR/VR/MR projects.
- » Client budgets are nowhere near project expectations. This has continued to be the trend for last 4-5 years. Most companies are not allocating the necessary budgets for meaningful AR/MR applications. Too often, the AR/MR project is part of a larger experiential or advertising experience with extremely limited budget.
- » Funding is plentiful, but most of the money gets swallowed up by the largest corporations. Unfortunately small and medium sized companies are growing by acquisition into larger companies rather than solo development. Small and medium companies shoulder such a large amount of the risks to bring a product to market. It would be great to have some capital or resources to bring visibility to these smaller projects before they are selling off company assets.
- » In the US, funding for AR/VR/MR projects for indie developers like ourselves is extremely hard to come by. I feel that small studios' lack of access to the funding necessary to properly develop a product is the number one thing holding back innovation, progress, and market penetration in the AR/VR/MR landscape.
- » It's highly dependent on what industry you're a part of. Example being, during my time doing AR/VR research at universities, we had to constantly fight to even be considered for funding anything related to AR/VR. Meanwhile at my current private-industry company we have an abundance of funding coming from multiple sources. So to judge it as a whole is fairly inaccurate. Companies like Dell, Microsoft, Nvidia etc. find this field highly lucrative and will put significant funding towards it. While others like 3M might see the value of it in applications like safety and training, but won't want to put full department investment towards any further research and development.
- » Necessary. I am starting to return revenue from my business but still need additional funding to get to profitability in the next 2-3 years. I have gotten many types of funding at this point, including VC. I am still seeking more VC and other types of non dilutive funding sources to not just sustain, but grow our platform.
- » Since they're fairly new and not a widely accepted mediums, the money isn't as easy to come by. Funding for social good projects are difficult, so we're always looking into ways to work with brands, to help tap into the money. Big brands and agencies seems to be where we make most of our money when it comes to XR work.

## ***When do you believe your AR/VR/MR project(s) will generate a profit for you or your client(s)?***

---

### **Currently profitable**

- » We have a small but talented dev team, and cross bill our projects to other divisions within a large company, sold as ways to save money for their teams. The internal sales cover our teams budget, save other departments money, and generate an occasional outside contract.
- » We are profitable because we are bootstrapping it and doing all the work with a small team.
- » My company Accenture seems to be doing well within the XR field with clients right now.
- » All of our products are now both 2D and VR based, with a few exceptions (one is exclusively VR and not practical in 2D). It's tough to separate development costs, but we are selling both.
- » Making close to \$300k in profit this year and only from XR projects.

### **Short term**

- » Can't currently share because of NDA
- » Low overhead
- » It's a game where AR is used to improve the experience. This means that the business model is solid.
- » Currently being tried out as pilot projects (paid but not at the market pricing yet)
- » We are in the early startup stage developing our workflow and tooling which takes extra effort and funds. We also need to reach scale to cover those and ongoing costs.

### **Medium term**

- » Our projected adoption rate puts us in the green in about 3 - 4 years
- » Depending on the company I'm advising or serving on the board, several of these answers apply. At least 2 of them made money on the advances received from Oculus, Sony, Google, et al. Most are not yet making money, but hope to once AR/VR/MR achieves greater market adoption.
- » Clients are actively paying us for prototypes and pilot projects.
- » The projects we're working on now are borderline too large, so it'll take a little while for them to earn a profit.

### **Long term**

- » We're in early phases and it's sort of a moonshot project. VR is incidental to Roborace and self-driving race cars in general - it can be involved at some point but the project doesn't revolve around it.
- » It takes a lot of time for schools to accept a new teaching method into their classrooms and curriculum, some teachers are very conservative and don't believe a mixed or flipped classroom will benefit their students, but only distract them (we've done hundreds of demos and this was some of the feedback). It takes time to complete studies and get them published in order for most to see the factual evidence of how educational tools and games benefit students. Our apps and tools have been out for a couple years now and we just got additional funding to complete the studies. So hopefully within the next year or so there will be a positive profit, not just for us but also save our clients a ton of money in the long haul.
- » Haven't actively marketed our experiences yet, but are moving to do so in next 6 months.
- » The market isn't mature enough for users to pay money. We still have early adopters and evangelists as users

### **Never**

- » Its an internal project for training/ education, not a commercial product.
- » All of our projects are part of larger franchise business models. They are meant to enhance a brand or platform, rather than to make money on their own.
- » Current project is a proof of concept demo.
- » We aren't looking to profit but to make educational materials filling in gaps that exist with commercially available solutions.
- » For educational and teaching purposes for high school students.
- » We're a non-profit, so the goal is not to make money. It's to increase traffic and involvement.

### **N/A - project not tied to profitability**

- » Our project is donor-funded and to be used at a University Health Sciences Library (and, hopefully, in future health sciences curricula) as a reference and training tool for health sciences students.
- » Educational environment
- » Project is for internal company training use.
- » We are a non-profit organisation, who are focused on outcomes, learning objectives, research and education.
- » It's an experiment to leverage the art form



## ***In the long term, which do you believe will eventually win the greatest market share?***

---

### **AR/MR**

- » AR / MR's correspondence to the physical world allows it to expand deeper, more directly, and faster into existing market environments. The number of applications for AR / MR tech is at least equal to current real world functions and extends its potential far out beyond that with increased raytracing, computation power and contextual awareness. VR will continue to provide immersive experiences better than AR, but the number of experiences that will require immersive content is far outweighed by those with direct connections to the physical world.
- » I'm taking this to mean the very long term, but I think that eventually AR can do everything VR can do, and more. But in a more realistic timeframe of say 10 years or sooner, VR is much more cost effective, and can do more. For our purposes, there are no AR headsets out there that can do what we need, including in development headsets we've gotten to try, and even if they did, they're not at a realistic price point.
- » AR/MR has a fundamentally lower barrier to entry than VR since I don't completely remove myself from the world around me. I can realistically use AR on my daily commute and on the toilet, just like my phone. That's why AR will eventually win.
- » Infinitely more real-world applications. Yet undiscovered improvements in productivity, workflow, and digital content interaction (including data manipulation), specifically in enterprise applications, will drive the largest market share. Comparable to the productivity bump MS Office provided for businesses.
- » The number of devices out there points to mobile phone AR winning in the next few years. I don't believe there will be a clear difference between the two in the long term. The device used for viewing content will be a secondary focus to the platforms themselves. We're largely focused on the hardware now, but this is a temporary state. The question is similar to a mac vs pc question in the 90s. Today it doesn't matter because the internet is platform agnostic.

### **VR**

- » The full immersion is far more powerful an experience. But the equipment needs to get smaller, more comfortable and cheaper to facilitate widespread adoption.
- » Gamers will be the main driver in the adoption of this technology, and VR meets their need for immersive and realistic gaming.
- » AR/MR maybe will have the largest market share for areas of VR/AR/MR however VR is and still will be the dominant immersive tool for product development (engineering, industrial design) and for customer experience (sales & marketing). As the product moves to production and manufacturing AR is the tool to go.
- » VR provides more control and immersion, engaging the player into entire virtual worlds designed to convey a thematic story, or accurately recreate a real world location that would be difficult or impossible to reach in reality.
- » Not sure really, I see them as appealing to somewhat different of audiences. To use a parallel in other media as an analogy, if AR/MR is like watching TV, then VR is like going to the theater. There are pros and cons to each, and different consumers are willing to make different trade-offs at different times.

## ***What have been the most significant market challenges in AR/VR/MR to date?***

---

- » For VR it's finding a solid business model, to survive with a company. Also getting the experience in the hands of a huge audience since the users are limited. Finally, people have sooo high expectations of how awesome the experience needs to be, and sometimes they don't realize, that we as a industry are like 1-2 years behind, when it comes to really knowledgeable early adopters expectations.
- » For VR: Adoption rate, low patience and high expectations, slow to achieve acceptable wireless 6DOF trainers. For AR/MR, data transfer and availability. The biggest use case for AR is augmenting data into the real world, which requires large amounts of data "at your fingertips". Also for AR, the really bad FOV makes it hard to use.
- » Lack of a large customer base. There isn't a large enough market to get a diverse offering of quality good compared to other mature technology markets that customers are familiar with. Without offerings, the customers stay away. Without customers, the offerings are not being made.

- » Since the tech is relatively seen still in early days the userbase for glasses/headset form factor devices is still small. At the same time the tech is rapidly changing which is great as it means rapid pace progress, but that also leads to a lot of constant learning and R&D needed by devs. Phone or tablet based AR has a large theoretical user base but in return there content and interaction forms are constrained as one constantly has to hold the device in the hands in front of one
- » Surviving the winter. Been in this game for more than 5 years. A lot of XR friends disappeared and were frustrated by the hype of 2015-2016, they got the feeling that thing would have been moving much faster.

### ***What projects do you think have best used AR/VR/MR in the last year and why?***

---

- » An example would be Vader Immortal, developed by ILMxLab, which manages to integrate compelling storytelling and interactive gameplay quite well.
- » Beat saber is a perfect example of using the current state of VR very well. It's simple, quick and easy to understand. It's basically an intro to VR game, which is perfect right now. I dont think most people are quite ready for the mmorpgs and more time consuming games yet.
- » Beat Saber, hands down. Genuinely fun, an intuitive use of the technology, great workout, addictive music. Everything you want in a great VR game. It gets you invested in the space and believing that you're there.
- » Beat Saber. Because its selling hardware. we don't need innovation right now. we just need grate software like Beat Saber sell we can sell enough hardware to have a viable AAA market.
- » Industrial applications - enterprise lever AR/VR/MR has had the most compelling use cases. Companies can justify spending time and money on industrial or enterprise AR/VR/MR when the use case is clear.
- » Pokémon Go still has done something nobody has come close to regarding engagement.

### ***What are you most excited about in the space over the next 12 months?***

---

- » The "Augmented Reality Framework" which is on-going at the ETSI: it should significantly help solve interop issues - The associated open-source initiative launched by b-com (SolAR).
- » The potential to use VR for medical applications 2) Apple claims that w/ the release of iOS 13, they are making it easier to build apps for iPad that easily port to macOS.
- » 5G and effective foveated rendering (I don't think wireless power transmission will be in the next 12 months).
- » A VR market that's finally big enough for small team projects, which hopefully will happen closer to the 12 month mark. More wireless VR products. Arena scale VR experiences. MR glasses and better tools for that.
- » Enterprise and professional growth who have more long term and impactful use cases in the works. Gaming cannot sustain or make the market grow to broad or early mass consumer adoption.
- » The development in the software ecosystem for PC-based VR, and advancements in display technologies. Light field technology is only a few years away from becoming successfully miniaturized, so watching how these markets will work to innovate on their current displays will be entertaining as the SDE has been almost eliminated from several display-based HMDs already through entertaining solutions (foveated rendering with eye tracking, or sub-pixel "cramming" have been surprising).