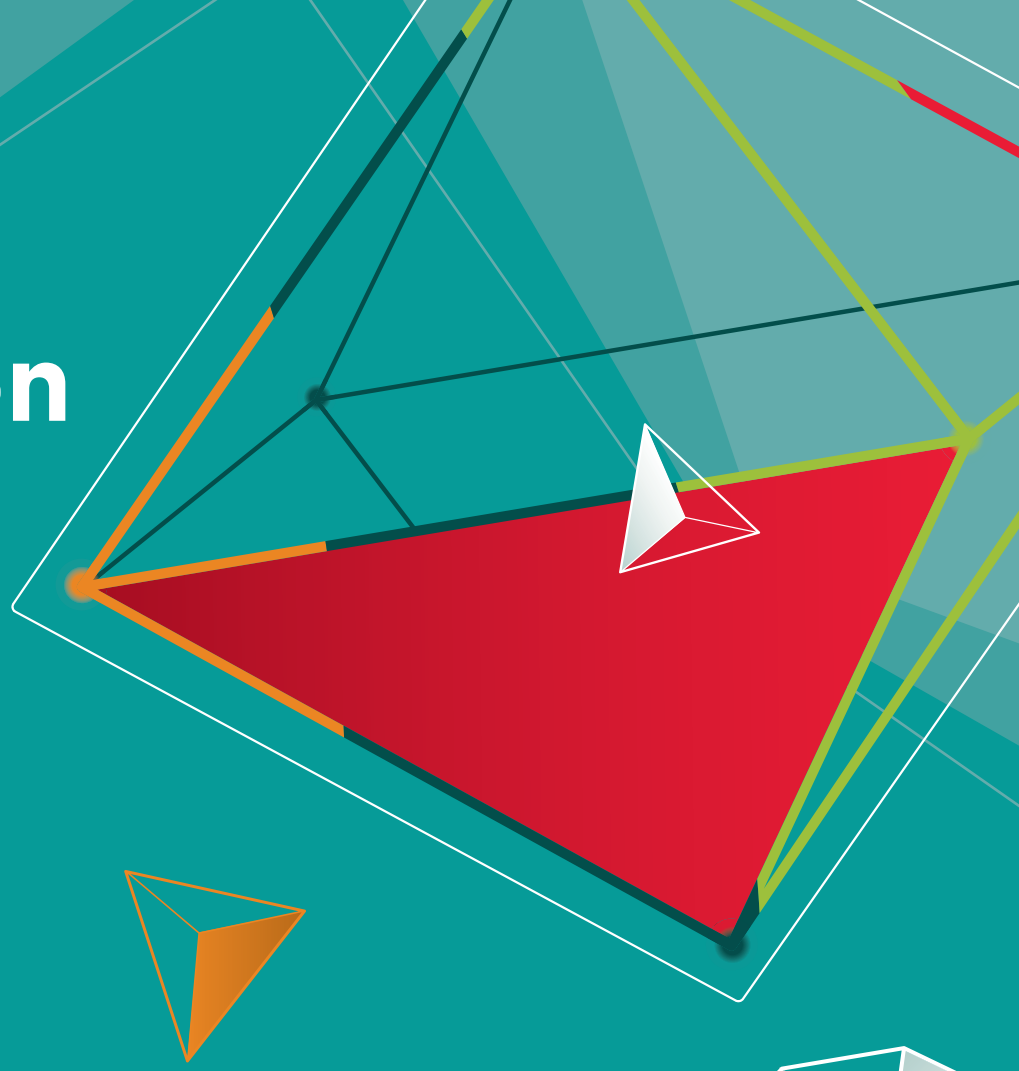
VR/AR Innovation Report

Presented by

VRDC FALL 2017

SEPTEMBER 21-22

HILTON SAN FRANCISCO UNION SQUARE



Welcome to the second annual VRDC VR/AR Innovation Report. The data in this report was gathered from surveying over 600 professionals involved in the development of virtual, augmented, and mixed reality experiences. The wealth of data it contains is intended to offer useful insight into a rapidly growing and diverse industry.

Some of the many interesting findings from this survey include a clear rise in the popularity of the HTC Vive and the Oculus Rift among industry professionals, an increasing interest in developing platform-exclusive experiences, and an understanding that most devs believe VR is a profitable, sustainable industry — but only in the mid- to long-term.

This data was collected, organized and presented by the UBM Game Network, which runs the Virtual Reality Developers Conference (VRDC) as well as the Game Developers Conference (GDC) and Gamasutra.com.

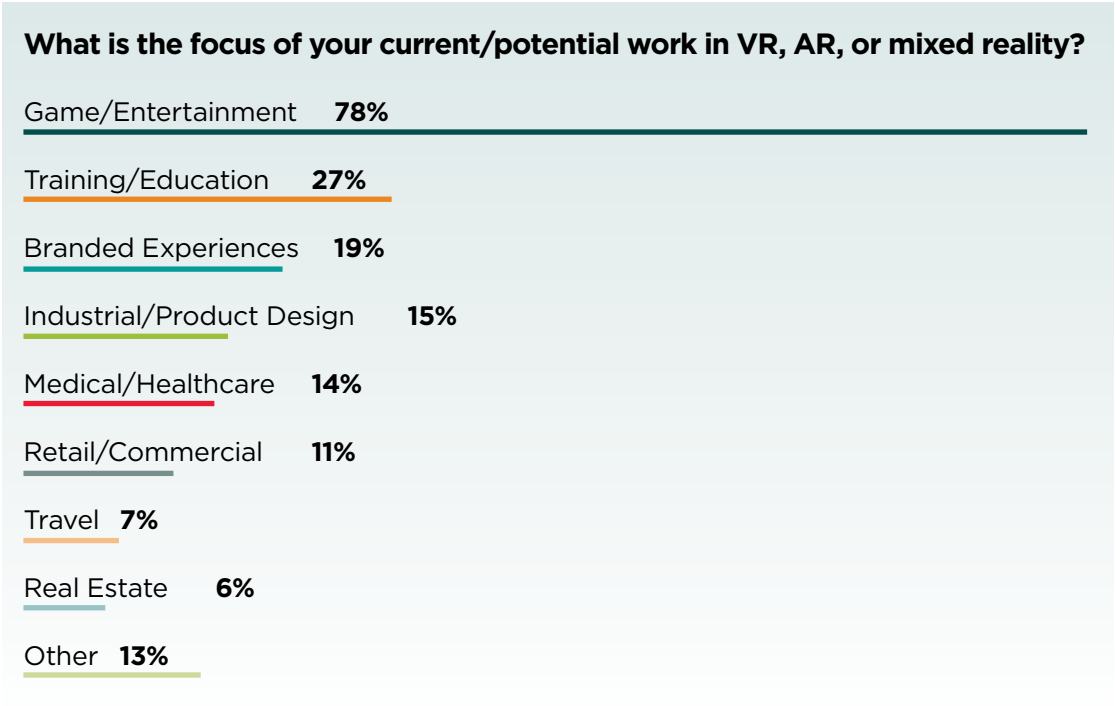
VRDC's next event will take place in San Francisco from September 21-22, 2017, bringing together creators of immersive experiences of all kinds—including games, entertainment, brand experience, healthcare, training, design, and more.

UBM

What Kinds of Experiences are VR/AR/MR Developers Making?

Given the broad scope of possibility in VR/AR/MR development, we thought it would be informative to survey industry professionals on what sorts of experiences they're focused on making.

When we asked survey respondents about the focus or focuses of their current or potential work in VR/AR/MR development, the majority (78 percent) said Games/Entertainment.



The second most popular response proved to be Training/Education, which was selected by 27 percent of respondents. Branded Experiences took third, with 19 percent of respondents saying such productions (think: car showrooms or vacation hotspots, rendered in VR) were focuses of their work.

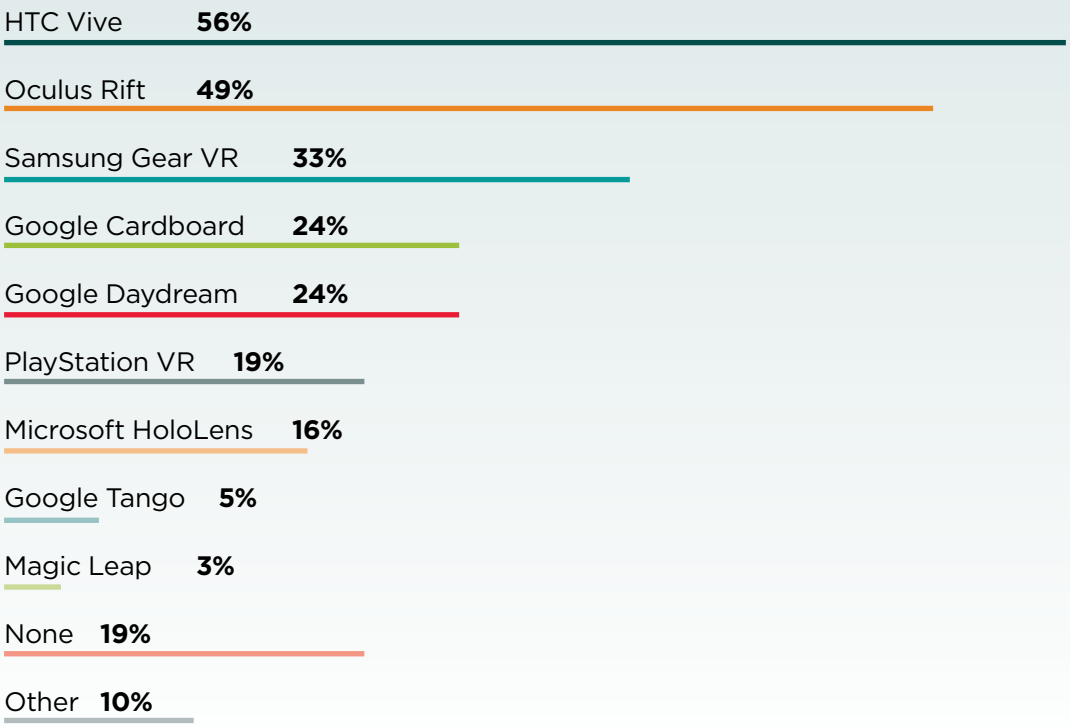
HTC Vive Remains the Most Popular Platform Among VR/AR/MR Devs — But Rift is Poised to Close the Gap

It's a perennially important question: what hardware are VR/AR/MR industry professionals targeting, and why?

When we put the question to our survey respondents this year, their responses roughly matched up with the results of our inaugural Innovation Survey last year.

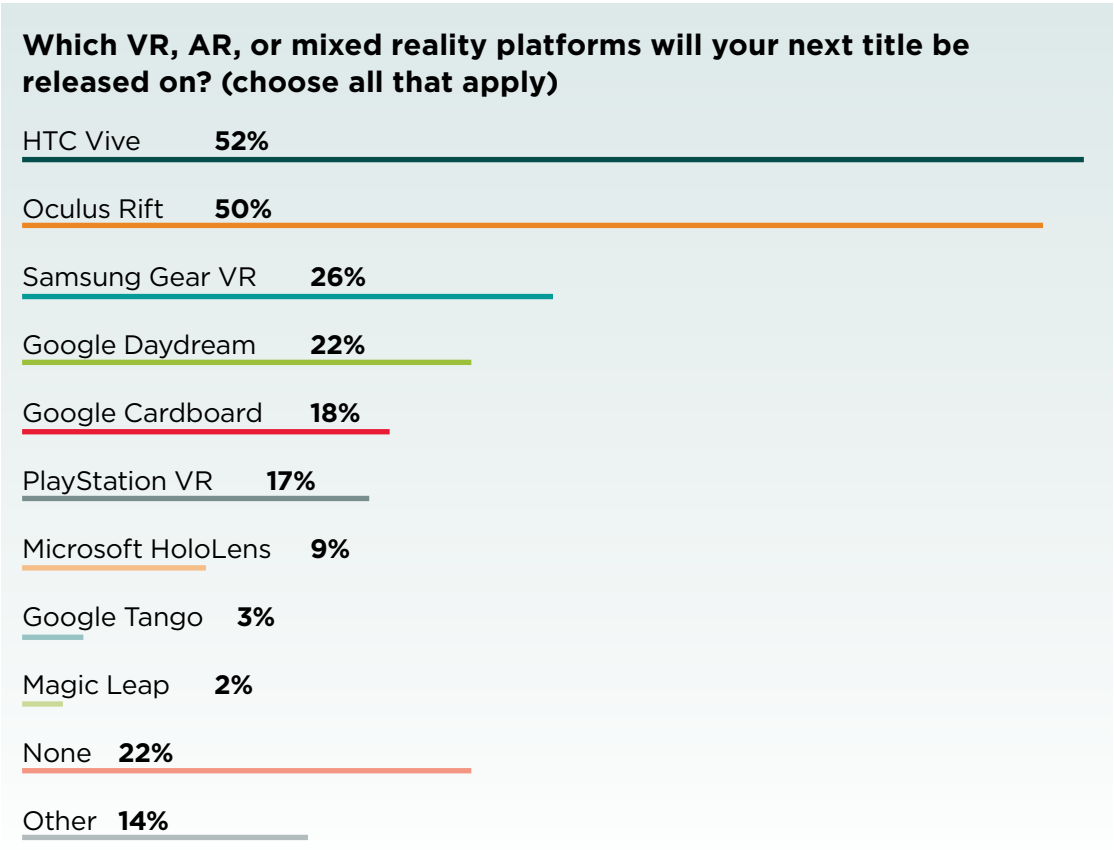
When asked which VR, AR, or MR headsets they were targeting right now, more than half (56 percent) of respondents said the HTC Vive. 49 percent said they were targeting the Oculus Rift, and 33 percent said they were developing experiences for Samsung's Gear VR platform.

Which VR, AR, or mixed reality platform(s) are you developing for right now? (choose all that apply)



Compared against last year's survey results, we see a small but notable uptick in developer interest in the HTC Vive and the Rift. Last year, 49 percent of survey respondents said they were targeting the HTC Vive, 43 percent said Oculus Rift, and 34 percent said Samsung's Gear VR.

Also, this is the first year we asked about Magic Leap, the mixed-reality platform that's long been in development but has yet (at least, as of this publication) to really be presented to the public or given any public release date. Given how mysterious the platform yet is, it's interesting to note that 3 percent of survey respondents (or roughly 20 people) said they were currently focused on creating experiences for Magic Leap.



But if we look to the future, it appears as though Rift may be poised for a bit of a resurgence among devs. When we asked our kind survey respondents which VR/AR/MR platform(s) their next project would be released on, 52 percent said HTC Vive, 50 percent said Oculus Rift, and 26 percent said Gear VR. This suggests dev interest in Gear VR is cooling, even as Rift is seemingly becoming a more attractive platform.

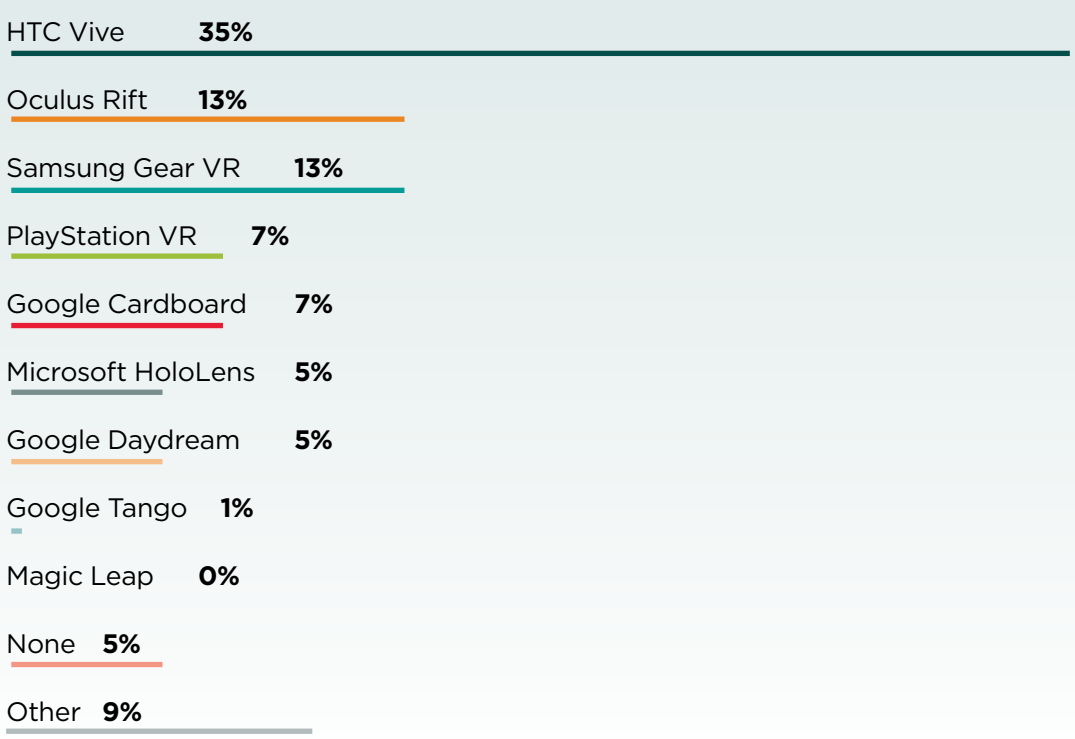
Platform Exclusives are Becoming a Bit More Common

How many VR/AR industry professionals are making something that will be exclusive to a single platform? About a third, according to our results — roughly 31 percent of survey respondents said their next project would be released exclusively on a single VR/AR/MR platform.

However, that's up 10 percent from last year, when we asked the same question and got a "Yes" from just 21 percent of respondents. This suggests rising interest in developing an experience for one platform first, perhaps because that's where they see their greatest chance of success — or simply because they intend to port their work to other platforms at a later date.

When we followed up with devs who answered in the affirmative to find out which platform, exactly, their next project would be exclusively released on, the most popular response proved to be HTC's Vive headset.

Which VR, AR, or mixed reality platform will your next title be exclusively released on? (choose one)

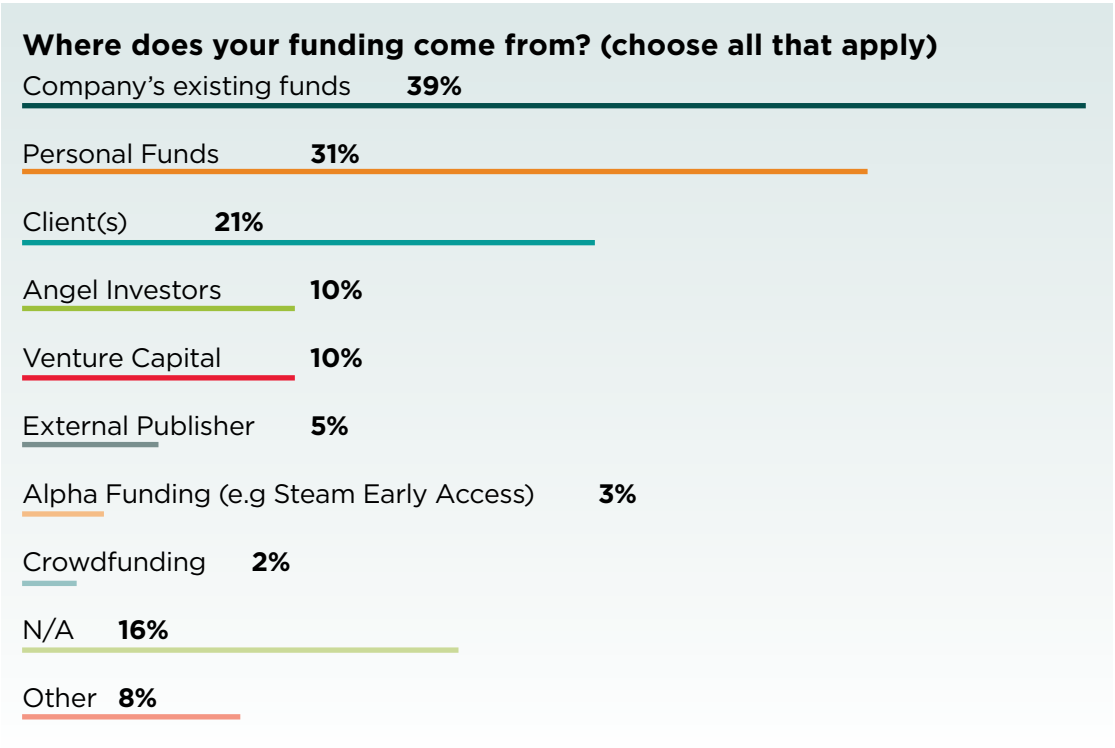


35 percent of devs working on a platform exclusive said it would release exclusively on Vive, 13 percent said Oculus Rift, and another 13 percent said Samsung's Gear VR headset. 9 percent said "Other", and just 7 percent said Sony's PlayStation VR.

Most VR/AR/MR Devs are Still Self-Funding as External Investment Dips

A lot of money has been invested in the VR/AR/MR industries over the past few years, but according to the industry professionals we surveyed, most projects are still being funded out of company (or personal) coffers.

When we asked our survey respondents to tell us where their funding comes from, 39 percent said their company's existing funds, 31 percent said they were tapping their own personal funds, and 21 percent said they were getting funding from a client or clients.



That's a bit of a reversal from last year, when we asked the same question and saw that 49 percent of respondents were using personal funds, while just 33 percent were using company funds and 16 percent were accepting funding from clients.

This data paints a picture of an industry that is becoming more established, with more production companies and clients fueling production of new experiences.

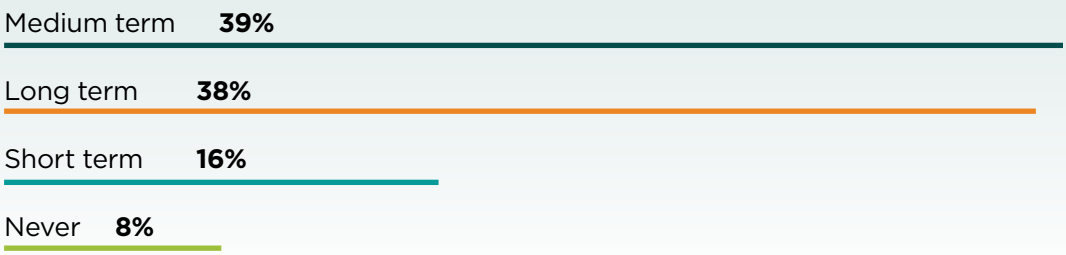
It's also interesting to note that this year angel investment and venture capital investment each accounted for about 10 percent of respondents' funding sources. That's a slight dip compared to last year, when 13 percent said they were getting some funding from angel investors and 10 percent said they were getting money from VC. This reinforces recent reports that external financial investment in the VR/AR/MR industries has dried up somewhat since the salad days of 2015 and 2016.

Industry Professionals Typically Believe VR/AR/MR is Sustainable — But Not Profitable in the Short-Term

But while money still flows freely through the VR/AR/MR industries, it's clear that most industry professionals aren't expecting to turn a profit in the short-term.

When we asked industry professionals about when they believed VR, AR, or MR would generate a profit for them or their client, just 16 percent said in the short-term, 39 percent said medium-term, and 38 percent said only in the long-term.

When do you believe VR, AR, or mixed reality will generate a profit for you or your client?



One of the respondents who said VR was profitable in the short-term commented that "We are already profitable doing AR/VR development for clients."

"The platforms for the technologies are numerous, but the experiences are quite monotonous for now," wrote one respondent who believed VR will be profitable in the medium-term. "In a couple of years, designers will be able to deliver the experiences they craft in several ways tending to individual needs."

"The platforms for the technologies are numerous, but the experiences are quite monotonous for now."

"The market still must mature," commented one respondent who expected VR to be profitable only in the long-term. "We are now in the 'trough of disillusionment' and there is no indicator as to exactly when that will end. I believe it has much to do with hardware."

Amusingly, 8 percent said "Never" (respondents could give multiple responses, as necessary), though many who did so added that they were working on student projects or not-for-profit endeavors.

And when we followed up by asking whether or not respondents thought VR, AR, or MR were long-term sustainable markets, the vast majority — 95 percent — said yes. That's exactly the same response we got when we asked the same question last year, suggesting the ups and downs of the last year have not diminished devs' interest in VR/AR/MR.

Most Devs Believe AR/MR Will Be More Popular Than VR In the Long-Term

Given that augmented- and mixed-reality technologies are often talked up as being more commercially viable than virtual-reality tech, we thought it would be interesting to survey industry professionals about the issue.

Turns out, a majority of them agree. When we asked survey respondents whether they thought AR or MR would win greater market share than VR in the long-term, 77 percent said yes.

"I worked in the AR industry for a while," added one respondent who said yes. "It's a much easier concept for clients to grasp, and instead of being a platform in and of itself, it can be seen much more easily as a tool to make existing platforms better. I always pitched AR as a visualization tool rather than a new platform. New platforms scare people. Tools, on the other hand, are greatly appreciated."

Another opined that "Mixed Reality is the end-game for VR. It will take more time to do it right than VR-only experiences, but offers much more to users."

However, one respondent who didn't believe AR/MR would become more popular than VR commented that the question was "Apples and oranges. VR is better for storytelling. AR is better for integration with real world."

> *"Mixed reality is the end-game for VR. It will take more time to do it right than VR-only experiences, but offers much more to users."*

VR's Biggest Failures Include Lack of Subsidized Hardware, Enterprise Applications and Native VR Experiences

Now that a wave of consumer-grade headsets have hit the market and the VR industry seems poised to mature, we thought it would be interesting to ask devs what they felt the biggest mistake of the VR, AR, or MR market(s) has been thus far.

We got a lot of great responses, many of which revolved around price, lack of compelling content, and hardware manufacturers' perceived failure to effectively market VR systems and software.

According to one respondent, the biggest failure of VR thus far has been "Not subsidizing the cost of headsets. This is what caused smartphones to get such adoption. If the iPhone cost $1,200 when it first launched, we would have seen the same slow growth as VR."

"Focus on technology instead of new content," added another. "Trying to uphold traditional designs and transport them to VR instead of creating new designs."

> *"If the iPhone cost $1,200 when it first launched, we would have seen the same slow growth as VR."*

"Possibly marketing too much around games/entertainment and not enough around business applications," suggested a third. "Gives the impression of being a 'toy' instead of the world-changing technology that it really is."

"VR needed to embrace the enterprise first and get essential elements and cost down before going retail with unproven experiences," responded another.

"Pushing to consumers too early with little content and overly expensive hardware," replied one respondent.

Devs Say Nausea, Accessibility, and a Lack of Shared Standards are Among the Biggest Unsolved Problems Facing VR/AR/MR

And while the VR/AR/MR industries have all made significant advances in the last few years, many challenges still remain. When we asked our survey respondents what they thought the biggest unsolved problem of VR, AR, or MR was (in terms of either technology or design), we learned a lot.

"The hardware needs to shrink considerably before AR/VR can really become useful outside of the niche market it currently serves."

Notably, we saw that many still feel like VR's greatest unsolved problem is the high risk of causing nausea and physical discomfort.

"The biggest issue is definitely the lack of available 'simulator sickness' mitigation techniques," opined one respondent. "Since each VR application offers a unique user experience, no one mitigation technique can service all applications. Future designs must consider the medium/genre they are developing for and continue to investigate new mitigation techniques to ensure optimal user enjoyment."

"A lack of standards," commented another. "The onus for understanding compatibility shouldn't have to fall on the consumer. The consumer doesn't worry if they have Dolby Digital or DTS; they buy a box, plug in the speakers, and the delivery pipeline sorts out the rest."

"The biggest problem is the cost of the hardware and the current limitations," wrote one respondent. "Soon as you can fit a Vive or Rift into your purse, things will change."

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Another respondent said, basically, that VR's greatest unsolved problem lies in supporting meaningful, extended experiences.

"Technology: Eye strain which prevents long sessions," they wrote. "Design: Design that merits longer play sessions."

"In AR, it's definitely UIs versus the 3D content overlaid on the real world," commented someone else. "No one seems to have any idea how to solve a persistent, 2D UI being on screen at the same time as overlaid 3D content without the user's eyes going utterly cross-eyed."

"Head-mounted displays are unwieldy and uncomfortable," wrote another respondent. "The hardware needs to shrink considerably before AR/VR can really become useful outside of the niche market it currently serves."

What are Some Great Examples of VR/AR/MR Experiences?

It's no fun to end on a negative note, so we closed out our survey by asking respondents to tell us about what games or apps from the past year they think are particularly great examples of VR/AR/MR, and why.

"Google Earth VR and Google Street View VR," wrote one respondent. "Simple, immediately appealing, and the best experiences it creates are not insular but are about talking with people in the room while using it. Try this some time: Put someone in [VR] Street View of their childhood home and just let them walk around and talk."

"Try this sometime: put someone in [VR] Street View of their childhood home and just let them walk around and talk."

"I hate to say it, but Pokemon Go," wrote another. "It really made it easy for people to understand AR. NYT VR is also very good and provides an easy explanation for what could be."

"Notes on Blindness is an amazing experience that helps to illustrate concepts and experiences that would be hard to convey in another medium," added another respondent. "It's an excellent and deep experience, however relatively short it may be."

"[VR pain management experience] 'Cool!' uses immersion to reduce pain better than drugs," opined another survey-taker.

"Rec Room has done an excellent job of creating a fun, social VR experience," suggested another. "BigScreen makes it more efficient to work with remote teams in VR than through any other available technology."

"One of my favorite projects from this last year was the Virtual Reality album created by the musician Hot Sugar," said one respondent. "Being able to interact with the world to create the music in different ways was quite genius."

Real estate AR apps put the best functionality and practicality into the tech...It will have the best combination of 'hey that's cool' and 'it's actually helpful!'"

"Embarrassingly enough, the best almost-market implementation of AR/MR this past year was Snap, Inc. when they delivered their Spectacles in a very Willy Wonka manner," commented another respondent. "Real Estate AR apps put the best functionality and practicality into the tech, and I think its relative ease of implementation given the desired results...will have the best combination of 'hey that's cool' and 'it's actually helpful!' to help bring these technologies to a viable state within the market."


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APPENDIX: Literal Answers

When do you believe VR, AR, or mixed reality will generate a profit for you or your client, and why?

SHORT TERM

- Already has. We've been doing this for 20+ years. The consumer-oriented VR/AR headsets are the new thing.
- Already is.
- Commercially-focused development.
- Look at the current install base.
- Depends on the market. For ads it's very easy to benefit from VR in short term. Other markets, like industrial design, need to follow industry standards. It will take more time to evolve, since standards needs to be defined first.
- Development is primarily geared toward location-based entertainment / VR arcade attractions.
- Efficiencies in processes already contribute to making VR a success in the automotive design area.
- I think there is short-term potential for profitable niche markets and that's what I'm focusing on. Mass market profitability will be a ways away.
- It aids In generating interest and support for projects, which leads to faster turnaround on installation.
- It has to come.
- Its a very short but fun stylized shooter.
- Makes our university seem connected with current events and upcoming tech, which leads to increased enrollment.
- Most hype of VR is in the short term. For medium term, VR specs must improve (resolution) to remain viable.
- Short term for us as we are mainly a service company. For our clients, I believe that the consumer market is not big enough to provide profit to most.
- Small business, as well as targeting markets like architecture and design where using tech like this can save money even with the costs of paying for custom software and high end desktop computers, it can improve the design of the buildings or objects, and allow review by designers and clients before breaking ground or starting other costly processes.
- The rate of consumption due to the novelty of these entertainment (and industry) technologies will start out rapid, then plateau as novelty fades, then slowly rise as legitimacy sinks in to the market and practicality makes the lives of consumers affected. At this time, we are still in the rapid rise of novelty on the production and consumer ends.
- We already have clients.
- We are already gaining a profit from Virtual Reality. Our clients have seen a large influx of interest in VR and people always want to try the new technology.
- We are already profitable doing AR/VR development for clients.
- We are already profiting, so our clients do too. (rev share)
- We are an agency so we can make profit short term. The client probably is not.
- We are currently generating profit from VR projects due to the immediate need for VR/AR to supplement our rendering technology.
- We build profit into the development of titles for VR.
- We have several industries currently using our tech as a new solution in their existing workflow.
- We keep costs low, self-funded.
- We make custom content for several different clients and are paid by the job. This has really been a boost for our company.
- We use VR/AR to perform music live. So we can sell ourselves to music venues in the immediate term.
- We're already making revenue and expect to be profitably (if we choose) by EOY.
- We're already profitable.

APPENDIX: Literal Answers (Profit Generation, cont'd.)

MEDIUM TERM

- 2018 is going to be a big year for AR/VR.
- All software and hardware costs have already been paid for, so future applications will be an added value with higher fees and lower expenses.
- Arcades to bridge income in medium-term.
- At first it may be a novelty. In time, we believe it will be a go-to experience.
- At the moment, the sales are not that encouraging. But breaking even is enough for us at the moment, since we are looking to establish our studio as a reference in VR, in the medium to long term.
- Especially for AR the profit range seems longer if you want to make profit from the public, for now the only way to make REAL profit is from Microsoft, or medical/architectural companies.
- For enterprise clients, the ROI is clear in the medium term. The consumer market is yet taking form, so I have no hopes of creating a monetizable consumer-facing experience that'll make money anytime in the next 4-5 years.
- From statistics I've seen at Vision 2017, mostly it's games that are making money. I'm currently unemployed :(so I'd say medium-term, IF I get a job :).
- I believe the consumer price of VR technology must go down quite a bit before people really start buying headsets.
- I make arcades. They should break even before 6 months.
- I work in toys, where AR/VR is not a primary business but a possibility.
- I write the music for Survios' projects. I think they're definitely on to something, and there's definitely enough headsets out there for them to turn a profit upon the official release of Raw Data, but I think that their second and third games are what will generate sustainable profits. VR is new, so all of these studios need to develop their reputations right now in addition to content. Once the public trusts the developers, they'll start dropping more and more money on the products.
- In general, public uptake of specific devices and peripherals at additional expense to the consumer will be slow.
- it depends on the application.
- It feels like we are 12-24 months out on the consumer market booming to the point where it can support a large number of small VR developers.
- It is a growing market, but not a unicorn market for us. And not our primary market either.
- It's a Sim & Training product. We expect it to generate revenue immediately after release and be profitable (investment recouped) within the first 12-18 months.
- Keeping dev costs lean and launching within the next year should allow there to be some profit judging by the potential user-base vs amount of available software within the genre we are targeting.
- Location based monetization models — most revenue comes from public licensing during the shelf life of title — this means the extremely small consumer pool with high end VR isn't a detriment to high budget development for 2017.
- Not big enough market yet, but on the right sized project it will be worth it.
- Not till 2019 (potentially).
- Our strategy is to launch early, iterate with real customers, and grow with VR install base as it grows.
- People need to gain more confidence in the VR/AR system. Many are currently still waiting for the bugs to be ironed out and the overall price to come down before investing in a system. The people that are buying are waiting for their friends or trusted sites to recommend a system.
- Projects are still small and the industry is growing. As project scope increases, the foundation of experience will be laid that content developers can build off.
- Provides key service to major industry partner reducing their cost to do business.
- Slow but consistent uptake of good games.
- Spent a long time in development, will take time to make it back.
- Tech adoption.
- The industry needs better use cases to be truly marketable and generate profits at scale.
- The platforms for the technologies are numerous, but the experiences are quite monotonous for now. In a couple of years, designers will be able to deliver the experiences they craft in several ways tending to individual needs.

APPENDIX: Literal Answers (Profit Generation, cont'd.)

- VR is a new technology as well as there are problems with people getting nausea when play till then I cant see the VR/AR generating a profit.
- We expect to generate profit in 2018 as more accessible hardware comes out along with lower price points. We expect a broadening content library to benefit content creators like us as more people are drawn into the medium.
- We have revenue now and expect to break even roughly EOY if we want to. We will likely raise more instead and continue to grow.
- We're already doing commercial paid pilots that can measure ROI for our clients.

LONG TERM

- Real profit will come once the hardware is further evolved, in particular once augmented/mixed platforms are consumer-ready.
- It's the future of things to come!
- 2019/2020 - Quality content is lacking. It will take a few rounds of "crappy" content for a "smash" must-have application to arrive that will invariably be the must have. Standardization of HW and development platforms is a must. Too many dollars chasing after too many unsustainable(?) platforms.
- Able to push out in Early Access and improve VR functionality over a longer period of time rather than straight out release.
- Because I work for a company that doesn't have any ongoing project with VR yet.
- Broader application will be long-term.
- Currently the market is still small and slowly growing.
- Establishing a market for 3D scanning and use cases for it.
- Headset adoption rates are very low.
- Hopefully closer to the near-term, but consumer adoption is lagging and making for a very long road ahead. We have had difficulty identifying feasible opportunities w/ the current market.
- I am a single game dev working on my first commercial title. I mostly make first-person narratives. I would love for these to be released for VR, or even AR. However, as I am relying on personal funding, I cannot currently afford to invest in VR hardware. It will hopefully be an option in the future. In the meantime, I am trying to develop in a way that will allow for future adaptation/porting to VR platforms.
- I would check all three of these boxes if I could, but profitability will rise when hardware costs fall and software improves.
- Install base vs. production cost and learning the new medium.
- it is a long way to implement/ establish a digital academy to teach software updates for engines to the people working with it. The idea is to send them the HTC Vive and they can do pre-training at their plant.
- It is expanding but it feels like premature market. Need to take the long view.
- It's a revenue share project.
- It's still an early adopter market, we don't expect to make a profit or even break even for quite a while.
- I've decided that the market just isn't there yet, will be working on my projects as non-profit or pro-bono.
- Limited hardware adoption is the major stumbling block to creating a market.
- Market is still nascent. Investment must be played long.
- Market, device immaturity.
- Mass market access/adoption.
- Medical field takes a long time to deploy and generate revenue.
- Need more and cheaper hardware in people's hands.
- Need more consumer adoption which takes time.
- New platforms take more time to develop for, we are still defining the basics of good user experience, consumer base is small but growing so hard to make money investment back with a limited audience.
- Once we hit release, we should expect to see a profit from our work.
- Our current plans involve using mixed reality as a marketing tool so the payoff is hard to measure.
- Platforms aren't mature enough yet to support mass market needed for casual games.

APPENDIX: Literal Answers (Profit Generation, cont'd.)

- Requires a lot of R&D and they understand this.
- Since I'm exploring the social VR space, it's hard to sell the product in a conventional way. Plus the possible cost of SpatialOS.
- small user base, high costs in development.
- The customer base is tiny. It will take time and costs coming down to improve those chances.
- The main purpose is to gain VR know-how. Shot term profit is not expected.
- The market is still growing.
- The market is too small at present to solely support development of the scale that actually impresses end-users enough to attract them to the platform.
- The market still must mature. We are now in the "trough of disillusionment" and there is no indicator as to exactly when that will end. I believe it has much to do with hardware.
- There isn't a big enough market, and mobile experiences are a bit crap.
- There just aren't enough people who have the devices yet, or the devices that power the VR devices.
- There needs to be some consolidation in the vendor market and standardization of API's.
- There's a high cost barrier of entry for consumers so there isn't a huge audience.
- This is a first to market type of training device we are creating. We need to build and test it first.
- VR consoles are not priced competively enough to become household commodities.
- VR hardware (head mounted display) is too large and uncomfortable for general use.
- We already saw an uptick in attendees seeking out and finding the VR/AR programming that we put on at our event in 2017.
- We know this field is still in its infancy and are doing R&D to figure out the best use cases for our Arch firm.

NEVER

- Our work is non-profit and pro-bono.
- Our work is in an educational setting.
- I don't plan on charging money. This is more of an art project for me.
- Il id for education and training.
- I'm not currently focused on for-profit projects.
- I'm working on a student project that will probably never be sold on a storefront, but distributed for free.
- Independent game designer.
- Its a hobby.
- It's is viewed as a marketing effort. As such, it isn't expected to generate a profit.
- Looking for training capabilities not sales of product.
- Not currently developing for profit.
- Not really sure on this, but for Automotive it is several years out, too early to estimate.
- Not-for-profit company.
- Our organization is an educational institution.
- We are an FFRDC and can not generate money.
- We are doing research in education, not product development.
- We're in education, funding through other means.

APPENDIX: Literal Answers

In the long term, do you believe AR and/or mixed reality will eventually win greater market share than VR, and why?

YES

- ...wearing a VR headset is awkward in public!
- 1) AR/MR does not require dedicated space
  2) AR/MR can improve all activities in your life
  3) AR does not require specific calibration or multiple peripherals
  4) VR can exist within AR"
- Accessibility.
- Accessibility, potentially, as well as versatility. Our entire society would have to change to incorporate VR in daily life beyond situationally-specific contexts, but augmented reality means that you can incorporate it virtually anywhere
- Although I believe the two are integrated, AR is just more functional and it's nice to have at least a part of you in reality. VR is very immersive and can take you to new places, it's great for work, education and gaming but it's not part of an everyday functionality it cannot or will not be integrated into everyday living, for example, eating, sleeping exercising, for those things AR is just more functional.
- AR - when the physics is figured out (battery, cm-level positioning, etc.) - will greatly eclipse the use cases of VR and will become the primary interface for AI systems that will become mass marketed.
- AR / mixed reality will start appearing in our every day appliances and commonly used items. Car windshields, eye glasses, contacts, communication and more will all be using AR and mixed reality to relay information.
- AR allows greater association with our surroundings.
- AR and MR have an easier learning curve for consumers.
- AR and mixed reality both fulfill a niche environment of unexplored user-system interaction over VR, which provide equal, if not slightly more, user immersion. Eventually, AR/mixed reality will support the technology required to provide unique user experiences that merge a user's environment and their simulated interactions into a single, cohesive play session.
- AR can fulfill the same role in everyday life as the smartphone. VR is a specific entertainment platform, like a PC or Television/Console.
- AR for daily life routines VR for immersive and dedicated moments.
- AR has a bigger play space. It can be everywhere.
- AR has a more obvious application for business.
- AR has a much lower barrier to entry in terms of cost and learning how to use the devices. But I am equally confident in both fields doing well as the tech gets better.
- AR has more use in other industries aside from entertainment
- AR has more utility and is more readily accessible.
- AR is the end result goal. When properly achieved, it will do everything that VR can do as well as account for what is physically in the player's space.
- AR offers much greater opportunity for architectural and health care related applications.
- AR potentially has more lifestyle applications than VR (i.e more than gaming/ entertainment - which is VR's strong point).
- AR will be closer to the function of cell phones (a second brain that assists me), which has broader acceptance than the immersion function of VR.
- AR/MR devices will eventually have similar features VR devices, making a device that only VR obsolete.
- Augmented reality offers an immersive experience without the constrictions of VR.
- Because full immersion makes people feel vulnerable.
- Because in Virtual Reality you need to wear a headset or a suit or something that costs money and is also not that comfortable.Therefore I think AR or mixed reality will eventually win greater market share than VR.

APPENDIX: Literal Answers (Market Share, cont'd.)

- Because mixed reality and AR is the next major technological update to the human experience. VR will become increasingly useful, fun, and beautiful, but it won't be necessary in the same way that mixed reality and AR will be.
- Because of form factor. Ultimately we will probably have one device in the long terms that does all (XR).
- Because of its ability to be integrated in mundane, every day tasks.
- Because there is more space in the entire world than 6' from your computer.
- Broader application space in AR than in VR due to mixing with real-life images. This means it should be easier to find generally useful applications in real life than the complete reality lockdown in VR.
- Broader use of industrial and B2B applications.
- Can use AR anytime like we use our cell phones vs having to set aside time for VR to leave the real world.
- Completely closing off from the world is too much of a mental investment for something that's supposed to be a relaxing escape, if that makes sense. At least that's why I rarely do it anymore. And in the long term, VR on mobile is just a novelty because I truly feel there's no good way to make the inconvenience of blindfolding yourself and the convenience of a mobile platform meet anywhere in the middle on a single consonant product.
- Depends on application. In strictly entertainment, more likely VR. However, in broader application areas like tele-presence the mixed approach provides more design flexibility.
- Depends on how long term you are thinking. Eventually I'm guessing we'll have AR built into contacts or some sort of brain interface. But that could still be a long way out. I imagine that even in the long term VR will be around as people still want to "escape" and shut out the real world from time to time.
- Due to daily use enterprise applications.
- Easy to adopt.
- Enterprise and wider use cases. Gaming/entertainment may remain dominant on VR.
- Everything will probably land up under the umbrella term augmented reality.
- For total market (all forms of media/productivity/communications)- YES. For gaming NO.
- Functionally more useful than VR alone.
- Honestly, there's no way to know. It all depends on the creators and what they are producing for each. I think VR can sustain the entertainment world (i.e. games/films), but AR and MR will definitely lead the way for practical use, like architecture, interior design, medicine, martial arts, military, etc.
- HUD-based VR is largely incompatible with daily life due to the fact that it is solitary, takes you out of your environment and even away from your own body. AR/MR enrich the world without compromising your sense of self, the world, social interactions, etc.
- Humans don't want to feel closed off and alone, they want to feel opened up, enabled, and connected. VR is (was) a stepping stone, and investments in it should already be withdrawn by 2020 as AR, a true personal computing modifier, ramps up for market satiation.
- I think that VR devices will not survive exclusively. Headsets that also offer AR / MR afford a wider variety of experiences for the user. AR also lends itself to more ubiquitous use since it will blend into an existing world which will likely appeal to a wider market beyond (but also including) the fantasy and exclusive entertainment markets that VR draws from.
- I believe AR will be integrated into daily life (think mobile phone/second screen replacement) while VR with be used for education, gaming, and some enterprise.
- I believe AR will have a bigger market than VR but on different levels. Basically I think VR will have a bigger market on the game side and Mixed reality will share that with VR but AR will have more applicables and also have fundings from Architectural, schools and medical industry as well
- I believe it can have many more potential uses, outside the gaming industry, than VR.
- I believe the average citizen of the world needs more use cases than watching documentaries or playing games. Perhaps the healthcare and business sectors will utilize it more, but I would love to see our educational system adopt more products like Google Expeditions. In the meantime, it will be largely commercial promos or marketing that will take hold, obviously behind games industry. And porn. :(
- I believe with AR/Mixed Reality you will have a higher ceiling for developing products for the mass markets.

APPENDIX: Literal Answers (Market Share, cont'd.)

- I find it more compelling, have more potential for social integration, and doesn't blind the user to their surroundings.
- I see a convergence of these technologies. As headsets get better, so will the ability to subtract elements of reality from our experience (or all of it, in the case of VR).
- I think it's use in the simulation and training market is more important than in games. In those markets AR is probably going to be key.
- I think MR is the true wave of the future as it will allow people to interact with the world around them and the digital world. There are greater avenues for monetization with this technology and it's less alienating.
- I think that AR will be more mobile and thus more accessible to consumers for everyday use (think smartphone apps vs. browser-based.)
- I think that there are more applications for AR that can be used with/on top of existing technology where VR requires additional technology that does not currently exist.
- I think that virtual reality becoming more mainstream is the first step, so in the short term it will outperform AR/Mixed reality. In the long term I believe that AR/Mixed reality will appeal more to people for social reasons.
- I think they will differ very much, and so will be directed to different markets.
- I think VR will demonstrate the value, and the tech there will advance to include the users immediate environment as well as other users in the same space.
- I want to believe.
- I worked in the AR industry for a while. It's a much easier concept for clients to grasp, and instead of being a platform in and of itself, it can be seen much more easily as a tool to make existing platforms better. I always pitched AR as a visualization tool rather than a new platform. New platforms scare people. Tools, on the other hand, are greatly appreciated.
- In long term yes, because current tech is still to far away from a product for wide public. VR is closer for the mass market and MR will be an future adaptation of VR.
- In short - because of the accessibility in our everyday lives. But the gap will be small because VR and MR will be distinguished with just a click/gaze away thus making it fully compatible.
- Industrial, commercial and enterprise AR applications have more of an immediate business need to fulfill ... as opposed to discretionary gaming/entertainment.
- Integration with the real world will always be more functional, practical, and accessible than an immersive experience with a completely digital facsimile of a world, real or otherwise.
- It depends on the way people react.
- It has far more chances of being a general purpose platform and thus a wider audience to sell to.
- It integrates better in daily life.
- It is more natural to augment into the real world, if we put knowledge in...it becomes more natural and a perfect mix.
- It's less of an exclusive experience. There is usually less setup, and communication to people in AR is way easier than talking someone through VR
- Less obtrusive headgear needed (can be incorporated into glasses) whereas VR immersion requires entire-head covering.
- Less restrictions for person in terms of usability, less barrier to entry long term for both developers and users.
- Likely AR wins in the long run because the market potential and markets served have a larger revenue potential in things like construction, automotive, product design and enterprise collaboration. Where VR will focus on Games, Tourism and Cinematic VR that are more consumer focused and smaller revenue per user.
- Long-term, yes. Most people will not be willing to completely shut out the outside world to experience VR for any length of time. AR and mixed reality provides that blend of real world to virtual that most will find comfortable.
- Mixed Reality is the end-game for VR. It will take more time to do it right than VR-only experiences, but offers much more to users.

APPENDIX: Literal Answers (Market Share, cont'd.)

- Mixed reality will eventually be the best of both worlds.
- More accessible, less disruptive to people's lifestyle.
- More applications. More natural interactions.
- More inclusive and greater range.
- More mass market appeal.
- More real world opportunities to augment reality with meaningful and useful information.
- More social for groups, easier accessibility with mobile devices everywhere, applications are more applicable to what the camera sees.
- More uses.
- MR will because of ease of use.
- Non-gaming applications.
- People will need to see where they are going and will play while going about their business.
- Preexisting foothold in social media. Stickers, face swapping, beauty, etc. The conceptual learning curve for consumers is lower for AR and thus there is less cognitive dissonance.
- Probably not likely for another 10 years though, unless you are talking about smartphone AR in which case that might be adopted by consumers much earlier.
- Since people spend the majority of their time on the move, they will utilize the augmented experiences that their phone gives them. For example, if people are exploring a city and want to see information on where their friends are hanging out or information about a certain building, they can turn to their phone to find slices of info.
- The commercial (non-gaming) usages are much broader. It fixes an actual problem, whereas VR doesn't, it reminds me of 3D TV. Sure we've now got the technology to DO VR, but theres still unsolved problems around interface, and what games actually are compelling.
- The interface is too useful and compelling for it not to catch on (provided hardware can come down in price and reduce bulkiness).
- The onboarding process for VR is jarring as it takes you completely outside of the physical world you inhabit. The advantage of AR is that the user still is completely aware of their physical surroundings, does not pose such a high risk of vertigo, motion sickness, or the other potential side effects of VR.
- The questions on this survey make answering difficult. I believe in the long term there will only be one device. The application will either block out seeing the real world or not. I'm a bigger proponent of VR than AR personally.
- The tech isn't there yet, but once we have an FOV that is much larger and is scaled down to a pair of glasses, things will begin to get interesting for AR. I see VR as the choice for the next 10 years, but then AR will take over from there IMO.
- There are more everyday app/wearable opportunities with mixed reality/AR. The combined revenue of those apps will most likely surpass VR.
- There is a very small segment of the population that is willing to go full VR, mass adoption will be AR and/or mixed.
- There is even more potential in AR.
- There is more reality to it.
- They will just merge be available from the same hardware.. software will decide whether the experience is AR/VR/MR...
- This question is almost as irrelevant as asking if TV will win a greater market share than cinema. They are related, but can serve different purposes so both have a place.
- This will not be an either/or scenario. Natural evolution will see devices will be capable of AR and VR experiences - we're already seeing transparent OLD TVs at CES.
- Tough call - depends on display devices. If they get to the weight of sunglasses, then we'll have AR with us all the time. So, LONG term, yes.
- Very long term though, the technology needs to be far less obtrusive, safe to use on a daily basis, have really good battery life and field of view, etc...
- Very tough question. VR/AR will start to blend together. They're already 2 halves of the same coin, and will become more so. But over the next decade, I think the commercial applications for AR will

APPENDIX: Literal Answers (Market Share, cont'd.)

probably eclipse VR applications.

- VR goggles will succeed TVs / monitors (fully immersed session computing). In the long term, MR glasses will succeed phones (portable always on computing).
- VR has major limitation avoided by AR.
- VR is a alternative reality which naturally brings to fruition of single experiences which have a start and an end. When we'll have decent AR wearables, we'll have a constant interaction with AR softwares to add data and integratw our lifes with more input.
- VR is like using a PC while AR is like mobile phones. AR can integrate more seamlessly with our lives. VR would only become greater than AR if we decide to actually start living in VR instead of the real world.
- VR is limited to digital-only applications. AR can service nearly all of the same applications as well as incorporate the multitude of additional applications related to digital-integrations with the real world.
- VR is such an isolated experience. I think AR or mixed reality help make the experience more portable and/or social. Once you add that in, it should open up the market a bit more. Until the buy in and mobility of the products decrease and increase respectively, AR will have the advantage.
- VR might get confined to entertainment. But for AR, the area of application is much more.
- VR will be focused on specific markets, where AR/MR can provide a broader application.
- VR will be huge but AR will be much bigger because of the applications.
- VR will win out in gaming, as gamers often look for immersiveness in existing game styles. AR will gain the greater market share though as it is far more applicable to a variety of everyday uses (shopping, navigating, social media, casual gaming) and accessible to people who do not want to immerse themselves in VR.
- VR, at its core, is a closed off, singular experience. There are multiplayer versions of it, but you are generally interacting with an avatar as opposed to real people. That cognitive disconnect makes the experience seem a little less immersive than it could be. AR, on the other hand, is a naturally inclusive system. The digital content is overlaid on your physical perception of the world. Shared AR experiences aren't shared with a disembodied head. They are shared with real-life people that you know and care about. This feels like it is a part of your life as opposed to something you put on a headset to escape from. Not only that, but it can also be used to help your everyday life through things like navigation, tutorials, etc. VR simply can't provide this as it looks you off into a virtual world that is almost meant to be exclusive and away from the real world.
- Wearables will take over and dominate.
- Yes, but only in non-entertainment markets (like industrial applications).
- You can only wear a VR headset so many hours a day. An AR headset you could wear all day long.
- You don't have any feeling of sickness in the AR gear in comparison to VR.
- You walk around safely with natural light and near/far focusability easing the strain on your eyes.

NO

- Apples and oranges. VR is better for storytelling. AR is better for integration with real world
- AR is decent, but VR is far better for creating experiences, trainning, etc. AR is still very janky, and is a long way off from the visions everyone is sharing as their pre-rendered tech demos.
- AR/VR serve different purposes and can do different things, I don't think of them as even being on the same spectrum.
- Because the distinction is redundant. AR and VR drink from the same well of spatial/immersive technologies. Sure, just like the mobile phone has a greater install base than laptops and desktops, we'll eventually see something similar with lightweight AR/MR glasses vs heavy duty MR or VR headsets.
- Because the VR entertainment market will be huge, but I do believe AR will see more success in industry/business
- Because this is comparing apples with oranges. They are complementary technologies and don't compete against one another.
- Because VR's infrastructure is much more robust: you can visit a museum in VR but not in AR (without a significant hamper).
- Both will have a place and the lines between the two will become blurred.

APPENDIX: Literal Answers (Market Share, cont'd.)

- Consumers want entertainment for VR, whereas AR seems to be more for productivity.
- Field of View will be an issue for the next 3-5 years
- Hard for me to say; it seems like VR could reduce the need to be out in the 'real' world which would make it more attractive - however, there may still be some *R's left that we haven't even discovered that are even more attractive.
- I believe both of them will have same level of importance, AR introduces gateway to VR and vice versa.
- I believe there are a lot of applications for entertainment as well as simulation training, which is something that AR doesn't or wouldn't do as well.
- I see great potential in both areas.
- I think by the time mixed reality catches up with VR in terms of experience the boundaries between the 3 fields will blur - a single device will allow a continuum of how much of the real world you include in your virtual experience.
- I think it's better to think of all three as a continuum rather than discrete media forms.
- I think that the difference between the two will become less observable as time and development go into it
- I think the escapist ability in VR outweighs the practical potential of everyday AR.
- I think they'll merge so that you're experiencing the same content, but with different devices as is convenient, including via HMD.
- I think VR has the edge in the extreme long term as an entertainment medium. AR/mixed reality will have greater short to medium term success simply because it's easier to create and to experience.
- I'm not sure actually.
- In games, no.
- In the long term, headsets will include both AR/VR.
- It depends on what you mean by "market share". Number of users? Dollars generated? They aren't necessarily related. People want to completely escape their lives more than they want to have a dinosaur on their desktop.
- It is my belief that AR/MR will dominate the day-to-day activities. However VR will become the escapism for the private space. Playing on traditional flat screens will become the retro form of gaming, while VR becomes the go-to in the household.
- It is not ADA compliant so mass adoption cannot occur in government, health care and education.
- It's a bit of semantic game. I think VR that is aware of the real world and incorporates it into its collision map, but does full visual field replacement will be a big deal long term.
- Long-term we expect autonomous vehicles and not sure they will need AR.
- Maybe in the very very long term but the technologies will merge and the distinction will be moot.
- My answer is specifically for games and entertainment businesses.
- My answer was yes last year, however seeing that it's just using the camera phone, with apps on 2d screens, i'm thinking it will be fun for a bit, but not provide an experience that's better than a regular 2d game.
- NO OPINION.
- Not for games.
- Not sure.
- Not sure - really depends on the adoption... driven by form factor, cost, use-cases, and software built.
- Not sure.
- People can relate to and imagine it better. It is more easily integrated into what they currently do.
- People want to escape reality just as much as they'd like to augment it. The human desire for complete immersion within a more appealing version of reality shouldn't be underestimated.
- People want to escape their lives completely sometimes. Sometimes they want to add cool stuff to it.
- Right now, AR is a little more cost-effective for the consumer. When headsets become more affordable and more easily accessible, we believe VR will have a greater market share.
- Straight-up VR is less expensive to develop and more costly as a consumer (unless you are talking something like Pokemon Go as AR). Mixed reality, in particular, will be the big "final frontier" for a long time, and won't be able to scale up with technology as fast as VR.

APPENDIX: Literal Answers (Market Share, cont'd.)

- The biggest (only?) advantage of AR over VR is you can still interact with the physical world around you, however, there are plenty of experiences that do not require real world.interaction, and for the ones that do, there are more and more products being regularly released that track physical items for use in a VR space. The immersion potential in VR is always going to be significantly higher than that of AR. that said, it depends what you are developing. Outside the entertainment industry, there are more practical 'every day' use cases for AR, which is an unrealistic expectation for VR.
- The difference between AR and VR is a false dichotomy — the "dream" headset of the next few years will certainly be capable of pushing both AR (digital images take up part of the user's FOV) and VR (digital images take up all of the user's FOV). As a temporary distinction it's not really worth differentiating between the two as separate markets.
- The technology behind AR is far too thin. It will be more like the wearables market than a mass market proposition. VR will stay bigger.
- There is no such thing as VR. The things we call VR/AR/MR are different technologies that serve bandwidth between humans and machines in different ways. All Immersive Computing involves elements of real world sensory information. You can't get rid of gravity, you still sense where your limbs are and you feel the solid objects around you.
- There will eventually be no separation in the two. The only different types of devices will be for industrial or other very specific uses where the device must fit into a specific scenario. The main split in the future will be mobile vs desktop, and even desktop will be wireless.
- They are completely different experiences.
- They are different things. We need to stop putting them as mutually exclusive competing platforms.
- They look similarly but they are different kind of experiences so I think both may have an equal market share in the future.
- They will eventually be a single device capable of both.
- They're different.
- Vr is more powerful in terms OS experience.
- VR is a more complete entertainment experience, with fewer developmental complications in terms of integration into real world environments.
- VR is more immersive.
- Yes, just like mobile phones (new AR/MXR) compared to console games (VR).

What has been the biggest mistake made by the VR, AR, or mixed reality market to date?

- 360 video.
- ADA compliance.
- Adapting old designs to new constraints.
- Adopting console-like mindset before the market is big enough — which result in lots of exclusive titles and seriously fragmenting a already small market. OpenXR is a step in the right direction.
- All products seem to not work well in a corporate environment with the company firewall. Many products were bought and dropped for that reason.
- All the "horror experience" development. It seemed like half the devs I talked to at the last VRDC were building them. A waste of time and energy for most of them.
- An emphasis on technology over content.
- Analysts going wild with estimates.
- Anticipating early adoption at record pace, rather than letting it build organically
- Any assumptions that today's tech represents a finished media experience are false. The tech is changing quickly
- Applications/Experiences not refined.
- As of right now gaming needs better graphics and recongnize motion faster.

APPENDIX: Literal Answers (Industry Mistakes, cont'd.)

- As with all new technologies, the high financial and technical entry barriers prevent many potential users from experiencing these platforms. While initial technology price points could only service early adopters willing to pay such a premium, continued advancements should not be barred from adoption by equally or higher financial barriers. At minimum, these technologies should embrace a subscriber model for user experience, allowing users to rent device-associated applications at a reduced cost and optimally enjoy its content without having to face premium, extraneous costs.
- Assuming mobile VR is just like mobile games.
- Assuming that everybody knows what's going on. Cardboard is/was a brilliant way too introduce the medium.
- Assuming the "boom" would be bigger than it was.
- Assuming the adoption curve is faster
- Assuming the market is big enough too sustain large project organically.
- Assuming too much in terms of consumer adoption based on equipment pricing. Just because something is affordable in the Bay/LA/Seattle doesn't mean that the rest of the country can afford it. Need too fund and support companies from all over the country instead of focusing on locals or expecting people too relocate too the West Coast.
- Assumptions about hard and fast rules in development.
- Bad customer experience.
- Barrier too entry. Cost.
- Being mostly available on Windows and Android and not throwing more at WebVR.
- Believing that VR would be adopted quickly before really proving why it would.
- Betting that HMD would be the larger market.
- Building VR that doesn't have a great experience
- Cables.
- Calling 360 video VR.
- Calling 360/panorama videos VR. A lot of people I show Vive scenarios too say that they've tried VR previously and are than happily surprised by how different high end VR can be, even with it's current downsides.
- Cheap 9D virtual reality "eggs" popping up everywhere, offering low quality experiences.
- Closed ecosystems like the Oculus store.
- Combining the terms "AR" and "VR" is the biggest mistake in my eyes. They are completely different.
- Communication too the rest of the market
- COMPLEX PROGRAMMING REQUIREMENTS.
- Computer hardware is not powerful enough yet at affordable levels. VR headsets are bulky and not that ergonomic and lack resolution. Hyped a bit too early but eventually it will take off very rapidly when hardware becomes affordable and mature.
- Confusing the public with terminology and lack of marketing investment from the platforms.
- Consumers are largely unaware of VR outside of the few HMDs they may have heard of, probably the GearVR, Cardboard, or Rift. Pokemon GO
- Correctly portraying the experience too those who haven't seen it first-hand.
- Cost and HMD size.
- Cost of experiences.
- Costs.
- Crappy efforts too port games too VR without really understanding the difference in the medium.
- Decent VR/AR devices are sold as a consumer products, being imperfect prototypes. This takes the consumer away, and is harder too sell VR software.
- developing based on desires over player comfort
- Development software (Unity) employs terminology largely unknown outside of 3d modeling and gaming. This makes entry quite difficult.
- Devices cost.

APPENDIX: Literal Answers (Industry Mistakes, cont'd.)

- Dishonesty in regard too deliverable and experiences.
- Do enough exposure too the public.
- Don't know.
- Early fights over market share between big players (exclusives, fragmented developer SDKs, political nonsense), lack of standards, devaluing of work (I can see spectacular VR experiences being sold too tiny audiences for less than $10, this is an abject failure), and way too much hype.
- Early fragmentation - although we are heading too standards far faster than previous devices.
- Ergonomics while users are doing training is hard too manage in a manageable way.
- Everyone pretending too be an expert. Not being braver with R&D experiences - believing too many of the 'you can't do this in VR' rules.
- Exclusives and fragmentation.
- Exclusivity deals.
- Exclusivity—without it would make it easier for anyone too experience good VR.
- Expecting great content too be created by unfunded indie developers.
- Expecting players too deal with large amount of friction too get into VR.
- Expense of hardware, not enough opportunity for the public too experience VR in particular.
- Expensive tech.
- Facebook alienating their original gamer market, letting steam surpass them. A ridiculous amount of hype around mobile VR experiences, when they just weren't there yet.
- Failure too identify what is wrong with the medium and what is needed too make it ready for mainstream. than failure too do what it takes through investment and research too fix those problems.
- Feature creep, never being able too agree technology is "good enough".
- Filmmakers are making films and video game developers are making games.
- First exposure too bad experienced in mobile VR makes general audiences misunderstand the high end VR experience and potential
- Focus on gaming when enterprise is likely a huge driver. 2. Social VR positioned as a way to meet strangers instead of connecting with friends.
- Focus on technology instead of new content. Trying too uphold traditional designs and transport them too VR instead of creating new designs
- Focusing on games and not shipping with 1:1 gesture controls standard.
- Focusing on gaming rather than other applications with clearer short-term needs and markets.
- Focusing on marketing, instead of workflow optimizations.
- Focusing on VR exclusively.
- Focusing too much on games, no risk taking in terms of products or "killer app", very high barrier too entry technology/spec wise.
- For all models trying too just focus on translating current apps and interactions too VR (like linear VR video) into a new medium with new interaction method and controls that never existed. Tilt Brush is a good example of the latter.
- For me it was when Oculus dropped support of Apple hardware after we developed on it for the SDKs.
- For Oculus, I think it has been the price too enter. PS4 and Gear VR seem too be doing well, and they are cheaper too enter.
- Forcing people too forgo their privacy too interact with AR games such as Pokemon Go.
- Fragmentation.
- Fragmentation. We need more standards.
- Fragmenting the platform.
- Funding PC/Console clones as launch titles. This never works. There is zero true VR fun. More investment should be made in indies and new genres. Need platform owners too show more design leadership and vision for new experiences on VR / AR hardware
- Game engine VR performance at runtime is not high enough
- Games focus on VR as a gimmick most of the time. Also most companies don't put enough research into it.

APPENDIX: Literal Answers (Industry Mistakes, cont'd.)

- Generating media hype too soon.
- Giving more expectations..
- Google Glass is a prime example of it. It marketed the future of a device as its current state. It also confused the idea of capturing video with the idea of augmenting something. People were quickly disappointed and pushed it off as a fad. Set expectations low, set dreams and aspirations high.
- Google Glass: releasing a prototype too test in the world, and the public wasn't ready for it yet (no fault on Google's part).
- Google Glasses, it set AR back years!
- Hardware fragmentation.
- Hardware should be smaller, lighter and wireless while achieving high quality.
- Hasn't been marketed the enough for the benefits it can and will provide .
- Headsets, and resolution.
- High cost.
- High costs for PC headsets. Huge diversification of joysticks on both PC and mobile.
- High device costs.
- High prices and few big apps/games.
- High prices of apps at launch.
- High prices, complexity, technologies lacking maturity.
- High promises.
- HMD still not mature enough too sustain the market potential.
- HMDs priced too high.
- Hype and over-promise.
- Hype cycle vs current reality.
- Hype, too many acronyms.
- Hype.
- Hyped expectations.
- I couldn't begin too answer the question here, we've released only one game so far.
- I don't have enough information too make this judgement.
- I don't know.
- I don't know.
- I don't know.
- I don't look at it that way. I think the market's evolution has been fairly reasonable... even investments, while overzealous in some areas (as with all new tech), has generally been measured. Insane investments in Magic Leap aren't smart (IMO), but I don't think we'll know what the biggest mistakes were for a while.
- I don't think that there is any big mistake in particular, but there are growing pains for a long emerging medium that is finally within the grasp of the mass consumer market.
- I don't think there are any big mistakes per say, just not enough of a selection or enticement - or no one knows about it.
- I don't think there are any major blunders. The market is just suffering under technical limitations before it can fully thrive.
- I think developers are not using VR too its full potential. Too many people are rushing title out in the hopes of a quick payout. VR allows people access too what used too be completely impossible design opportunities.
- I think the industry is doing a good job - Oculus messed up by giving their lead away too HTC by releasing late and without hand controllers.
- I think the progress of the technology is 'normal' meaning that there really haven't been any huge mistakes as yet made by the market. It is still very young so there is lots of opportunity for mistakes too be made.
- I think we are learning yet.
- Ignored for long period.

APPENDIX: Literal Answers (Industry Mistakes, cont'd.)

- Ignoring the past.
- Ignoring/reinventing the past.
- Improve the technology but not the content.
- Inability too properly explain benefits of VR/AR/MR too those without access too hardware.
- inability too reach general markets.
- Inaccessible pricing. Hardware manufacturers should be selling at a loss until the market share is higher.
- Inflated expectations about potential revenue (the trough of disillusionment). Hardware availability/ price hasn't helped much either.
- Introducing this too consumer market a little too early.
- Investors getting on the hype train.
- Investors leaving VR too chase AR and wasting money, while killing off the tribal knowledge in companies who invested themselves in VR
- It hasn't explained what it's basic use is too consumers.
- It is understandable that the success of VR and AR depends on marketing, positive journalism and brand awareness, but I feel that the level of hype created around VR over the last few years pushed a nascent technology out of the door before it was truly ready. This had two effects. Firstly, many people's first experience of VR (mine included) was a bit janky or nauseating. Secondly a big price barrier was created. As an indie PC dev and as a player of games, I can't afford VR hardware. With many people shut out of the market, it will not grow, and it's possible that manufacturers will have difficulty releasing future hardware at more affordable price-points, due too risk factors etc. VR and AR will not truly take off until there is a more affordable model.
- It wouldn't technically be a mistake but I still believe VR requires too much processing power from computers.
- It's not a platform like a console, so we should stop treating it like a controller add-on and like its own thing.
- Its potential uses.
- Jumping on the bandwagon quickly too get something out - there is a lot of low quality advert-tech-demos stuff too wade through too find a product that actually warrants keeping a VR unit.
- Lack of AAA games.
- Lack of awareness in the public.
- Lack of compelling content. Choosing quantity of titles over quality of experiences.
- lack of conceptual and aesthetic vision and technical vision (everything relies on clichés)
- lack of content
- Lack of content (with support from sponsors), lack of standardization and involvement of peripheral industries.
- Lack of content and delays in shipping.
- Lack of cooperation at a strategic level
- lack of education too the consumer who have heard people have bad experiences so they don't even want too try it
- Lack of enterprise exposure
- Lack of open standards
- Lack of standardization its very fragmented.
- Lack of support for developers and studios. Thus, we are still waiting for good content.
- Launching at such high prices, and with just a few games too offer.
- Long periods of platform exclusivity, grow the market by putting all content everywhere. Walled garden stores. Difficulty of development - no heat tools for mobile.
- Long time in between iterations
- Low-quality VR being released too the public.
- Making hardware more accessible too more consumers, cost wise.
- Making too many of these stupid little 10 minute "experiences"

APPENDIX: Literal Answers (Industry Mistakes, cont'd.)

- Market fragmentation.
- Marketing getting ahead of itself. Branding 360° films as "VR".
- Marketing promised that "VR had arrived", when in reality it is arriving. If the public gets turned off too quickly than VR will never get the opportunity too develop as far as if the initial expectations were not as grand.
- Marketing terminology being fractured/poorly designed.
- Marketing to males, and not attempting to bring in the female market more effectively.
- Mis-estimated the growth of VR in the stages after the initial high-end consumer VR launches. A lot of clients/investors have "been burned" by the over-hype around the technology.
- Mixed messaging on explaining presence.
- Most AR applications looked for easy answers and went straight for enterprise to generate greater revenue, but VR is succeeding by going straight to consumers, so adoption was much faster and advances more quickly
- Motion tracking controllers not a standard option (or pack in) on every platform.
- Moving too fast without solving the technical issues that lead too motion sickness or discomfort.
- Multiple standards. Everyone should start coalescing on one standard or build to a common API.
- No big mistake.
- No idea.
- No killer app.
- No mistakes, just slow building momentum.
- No mistakes.
- No one.
- Non-conformity of platforms.
- None.
- None.
- None.
- None?
- Not accommodating a diverse user base (women, people of different ages and cultures, etc.)
- Not being clear with early adopters and developers that this is a long-term proposition. Not many developers will make money in the short-term.
- Not being customer friendly. must be more publicized.
- Not being honest in the quality of the device. The devices are fantastic without having too show "marketing videos"
- Not bringing hardware cost down fast enough
- Not building an ecosystem of interaction design experimenters that do not need too make a profit and share their discoveries too everyone in the industry. eg. academia, insulated skunk works, etc.
- Not committing fully to VR products
- Not creating an affordable and high-quality headset/glasses.
- Not creating content for the mass market early enough.
- Not creating enough engaging content that makes consumers want too return and reuse the device.
- Not designing the game with the limitations and characteristics of VR in mind.
- Not educating consumer/journalists fully/honestly. Industry keeps trying too hide which motion sensors are fusing their output inside the device, or pretend that 3DOF controllers are just as good as 6DOF. "It's magic" leads too consumers not trusting or differentiating tech.
- Not emphasizing web / mobile phone based. condemned market too low volume.
- Not enough attention paid to the pioneer Prof. Steve Mann
- Not enough compelling experiences.
- Not enough content. Store fragmentation.
- Not enough data to support it.

APPENDIX: Literal Answers (Industry Mistakes, cont'd.)

- Not enough varied content.
- Not establishing a universal software standard from the get go. OpenXR is years away.
- Not getting content easily visible too consumers, there is a lot of stuff out there but too difficult too sort through the rubbish unless looking for established brands
- Not having a best-in-class game developer create a best-in-class VR experience tied too a mainstream IP too accelerate the technology's consumer adoption.
- Not investing in the content too sell the hardware.
- Not jumping into public services like teaching driving and forklift driving. HR scenarios/etc.
- Not pushing enough for in-house content makers.
- Not really any yet, but very weary of the (music) entertainment industry considering AR/VR content free for consumers. Same mistake as every technology surge in the past 50 years
- Not securing major development companies too produce main IP franchises so a customer base can be created.
- Not solving the entry level issues. Systems on too high priced for the average consumer and the use factor is too complex for most companies too invest in
- Not standardizing on specific software or drivers too encourage platform-agnostic development.
- Not subsidizing the cost of headsets. This is what caused smartphones too get such adoption. If the iPhone cost $1200 when it first launched, we would have seen the same slow growth as VR.
- Not sure
- Not sure.
- Not sure...Main problem is countries importation policies which make hardware less viable.
- Not telling positive stories and managing the message.
- Not thinking big enough. Limiting the concept too fancy storytelling, focusing on devices you wear on your head, not addressing "big picture" problem solving. It's a toy, not a tool.
- Oculus delaying hand controllers and shipping with Eve as the initial game.
- Oculus raised market expectations and drastically underperformed, which made the valley of despair much worse than it could have been. Oculus also drastically underinvested in content and wasted most of the $250M they say they have spent on VR content.
- Oculus-only releases like rock band. They're leaving money on the table by not releasing too the wider ecosystem
- One unified push, shouldn't have made games exclusive
- Over hyping the technology before it was fully ready. That said, I don't think that necessarily hurt the industry.
- Overestimating adoption speed.
- Overestimating the size of the early adopters market.
- Over-hype before resolution and content is available.
- Overhype is a problem, because only very recently can the experiences begin live up too the expectations. We need too regain trust of some early adopters.
- Overhype.
- Overhype.
- Overhyped, too many terrible experiences being touted as good; unrealistic timeframes on mass market acceptance
- Overhyping prototype technologies by passing off art of the end goal as the current working state.
- Overhyping the immediate revenue potential
- Overhyping the market. Should have stuck to B2B initially.
- Overpriced hardware & under supported software
- Over-promising, especially Magic Leap
- Overpromising.
- Oversell, rushing to ship consumer devices.
- Over-selling, under-delivering.

APPENDIX: Literal Answers (Industry Mistakes, cont'd.)

- Palmer Luckey.
- Perhaps this won't really count as a mistake of the market, but rather a barrier, and that is funding.
- Platform exclusivity deals.
- Pokemon Go.
- Porting content not built from the ground up for VR and not taking motion sickness into account when porting content with locomotion
- Positioning.
- Possibly marketing too much around games/entertainment and not enough around business applications. Gives the impression of being a "toy" instead of the world-changing technology that it really is.
- Price
- Price
- Price
- Price
- Price and performance is the issue for VR
- Price of equip.
- Pricing
- Pricing and content
- Probably the price of the headsets, they were created for very limited market.
- Probably the price point
- Profit predictions, price point management, and marketing.
- Promoting VR/AR as a gaming and entertainment-first platform.
- Publicity emphasis on nauseating experiences (tradeoff against early exposure hype) — deepened trough of disillusionment by accelerating the hype curve, IMO
- Publishing incredibly bad experiences and make people motion sick. It gives a bad reputation to the industry.
- Pushing to consumers too early with little content and overly expensive hardware.
- Pushing way too early
- Putting the focus on big flashy titles that focus more on AAA graphics than gameplay. These experiences are just too short and don't provide a reason too come back
- Released products for the various platforms that were incomplete or overly simple.
- Releasing tech which does not live up too the hype.
- Releasing too soon without a good go-too market strategy.
- Releasing without answers too the input problem and assuming people would work it out. Not having a clear strategy too grow the software ecosystem.
- Relying on the attractiveness of VR/AR as a new medium rather than focusing on applications that are actually useful. Making unrealistic/unfulfilled promises.\
- ROI projections.
- Roll out bad (non immersive products) too early
- Rollercoasters.
- Rushed products, no checks and balances as it pertains too quality of experiences, developers treating development of VR experiences like normal development.
- Rushing into release.
- Rushing poorly conceived solutions to market before they are ready developing a lack of trust with consumers. Rift is easily the best example, well below what was promised especially relative too UX
- Shaky releases, too expensive
- Shovelware. Too many low quality games, not enough headliners too draw in crowds. People see VR as the platform that "will be cool in 3 years"
- Sickness.
- Small number of substantial experiences

APPENDIX: Literal Answers (Industry Mistakes, cont'd.)

- Speed? It would be better if things were better faster (high def, low cost, etc.), but I would also like jetpacks, so... Also, figuring out a good solution for movement without nausea.
- Still searching for a compelling use case. The content doesn't deliver enough of a differentiated experience too overcome the cost and comfort issues.
- Technologies are too quick to market and/or too quick to make claims about their abilities.
- Teleporting for motion in VR, too clunky
- The biggest mistake has been Oculus' walled garden approach to VR software distribution. When a workaround like Revive is created to bypass your system, I believe it shows the people want something different than what you are offering, which in this case is the walled garden approach. Anything other than an open system is the biggest mistake.
- The biggest mistake has been to focus solely on quality first rather than addressing the ceiling of availability.
- The biggest mistake in my opinion would be the fact that there aren't enough developers pushing the quality of Google cardboard games. The biggest problem with being a VR developer is that we cater too a very limited number of buyers as not everyone has an Oculus rift or an HTC vive. The biggest advantage of the Google cardboard would be its accessibility and I believe that's something that developers should push too increase interest in VR, AR or mixed reality market.
- The community focuses entirely too much on predicting mass adoption instead of focusing on the compelling current uses of these technologies. As an example, Google marketed glass poorly, skipping the step of creating compelling use cases in the professional and industrial contexts. Consumers didn't understand what to do with it, so it failed, embarassingly so.
- The division of titles by different platforms. The lack of funding for indie developers.
- The experience has been too isolating.
- The focus on the high minspec for PC VR telling people that VR is expensive. You can easily make mobile-grade VR but with much higher immersion on a moderate PC-setup making VR accessible and affordable for a much wider group. I remember running the DK1 on my MacBook Pro from 2012. We need too include people, not exclude them with pay walls.
- The headset is way too expensive for general end-users
- The heavy emphasis on games for VR rather than practical applications does not appeal too devs or communities in the midwest as much as the coasts. If VR/AR/MR will succeed in the midwest, it will be due too architecture, engineering, educaiton, and health care.
- The hype of the experience is ahead of where the real technology is. As the industry we need too focus on right content and focusing on bringing better display ASAP too win over the consumers.
- The market research firms' relentless overhyping of the early VR attach rate (which the hardware companies had much closer too correct) caused serious optics issues when we were unable too match expectations that were not realistically set (and disagreed with by platform holders and developers!) too begin with.
- The Oculus releasing with no hands, and mobile VR not coming with a sort of clear explanation of why it is different than tethered VR. A lot of those experience make people sick.
- The over inflation and propagation of gaming being the end all be all of VR. I think AR has a great potential and VR for health and education is where I want too see more focused work. I think applications for the elderly is also a huge opportunity.
- The Rift and Vive could have launched stronger if the had a larger pool of experiences ready. Oculus should build more supply before launches, as the Rift was understocked at release.
- The technology was far ahead of market
- They tried to use traditional gamepads (XBox controller for Oculus). That's not how VR works!
- Things are being released too soon before being properly polished.
- Thinking it would be profitable right away.
- Timing
- Too early to launch without viable and cost-saving content pipelines. To much hype.
- Too early too know!
- Too expensive

APPENDIX: Literal Answers (Industry Mistakes, cont'd.)

- Too gimmicky...
- Too hard to make - get easier tools in the hands of creatives
- Too many controller based games, or other games just adapted not designed for VR
- Too many developers making the same content that the mainstream doesn't care about.
- Too many different platforms with content scattered through the all of them. Hardware is too expensive for mass market appeal.
- Too many extra tools.
- Too many headsets with difficult setup, you can only develop for one particular platform this divides the industry. Desktop VR is costly, not getting too enough consumers as iPhones not really support much in VR space. Not enough pixel phones daydream headsets, not enough funded content. Very little know how outside of the industry.
- Too many useless crappy conferences that focus on commercialization and making money rather than making compelling content.
- Too much content focused on Violence.
- Too much diversity in devices and approaches.
- Too much effort place on high end hardware.
- Too much focus on casual/party entertainment and not much focus on other areas (eg rpg, adventure, horror). In addition, haptic stimuli is largely overlooked.
- Too much focus on the entertainment/marketing verticals.
- Too much hype and funding.
- Too much hype, not enough quality content. We run the risk of a dot.bomb repeat.
- Too much hype, too much game content is based on design principles from other mediums that doesn't make the most of VR
- Too much money going into hardware and software instead of content.
- Too much press hype without a significant amount of content too back it up.
- Too much setup. End user experience is rough.
- Trying to fit existing non-VR game models into VR instead of developing something new.
- Trying to go too broad
- Trying too be the best at the moment too few people have these systems. They need to be more accessible.
- Trying too soon for too much.
- Use of controllers and banking on game developers for mass adoption and not investing in hand tracking, input is a real problem for designers and lack of accessibility cuts out a good portion of the mainstream market, there are no unified design standards, which produce bad VR AR mixed reality experiences, leading too further skepticism and gimmicky-ness perception of the industry as a whole
- User accessibility seems too be the key in the success of AR, VR in the long run. Right now, many people cannot afford the devices and won't be able too experience the contents in the roadmap.
- User experience not good enough for mainstream. Content not always suited for target (professional users and early adopters). Mobile VR is usually the 1st experience for many users and it's simply not good (not too mention all the crappy "virtual HMDs" confusing consumers)
- Valve, Facebook, and Sony should have released more high quality, AAA experiences along with their hardware that are more than just show pieces. Especially Sony, as their product had the biggest chance of reaching mainstream audiences off the bat and the games ranged from good but short too garbage.
- VR is by nature an isolating experience
- VR needed to embrace the enterprise first and get essential elements and cost down before going retail with unproven experiences
- We are starting to see some shovelware being put out, and that might over saturate the market more than we should.
- Weak Content commitment.
- With regards to video games and media, not hiring writers. As cool as the ideas tend too be they feel like nickelodeons. Just a lot of jumpscares and no content.

APPENDIX: Literal Answers (cont'd.)

What is the biggest unsolved technology or design problem in making VR, AR, or mixed reality experiences?

- $$$
- ...immersive or "wow" factor!
- 1. Headset is too heavy 2. There are too many wires 3. Device to support VR machine is too expensive.
- 4k displays.
- A better default solution than teleport for locomotion that doesn't cause nausea.
- A form factor that is cool and not dorky. 8k display, no motion sickness, 6dof immersion , untethered 60+ fps
- A lack of standards; the onus for understanding compatibility shouldn't have to fall on the consumer. The consumer doesn't worry if they have Dolby Digital or DTS; they buy a box, plug in the speakers, and the delivery pipeline sorts out the rest.
- Accessibility
- accurate tracking of a users full body without bulky equipment, and accurate representation of a users immediate environment; particularly for AR the biggest lack we've experienced is accurate markerless tracking in outdoor environments.
- Accurately capture movement on mobile devices
- ADA compliance and how to create a collaborative experience for a class.
- Affordability and accessability.
- Affordable price point in untethered 6DOF with hand tracking
- Again, fragmentation among the approach to interaction and needing a lot of custom solutions to combine different aspects of packages to meet client needs. (OpenVR is helping a lot)
- All platforms will benefit from an increase in computing power to support their goals. This basically just means more time.
- Any aspect that contributes to VR sickness / not lining up 1:1 with your brain.
- AR - It needs to be as immersive as VR. When demoing the Hololens not having a full 360 AR view takes me out of the experience. Also I didn't like that objects that seemed far away would not get lost when someone walked between me and the object.
- AR - recognition of surfaces such as ground, faces, objects
- AR and MR is very hard to try on mobile.
- AR headsets still need to show a much wider field-of-view for immersive applications.
- Attention spans, indiscreet wearables.
- Bandwidth, visual quality, motion sickness
- Battery life and/or tether.
- Battery technology.
- Being on the connection leash and isolation.
- Being tethered. FOV.
- Better input.
- Body tracking. (Leap Motion has come a long way on the hand tracking front, at least), but isn't quite there yet.
- Bridging people from the technology and behaviors they have today and into the future.
- Building a low end, consumer friendly VR kit.
- Bulky HMD's
- Bulkiness (VR & AR), FOV (AR), resolution (VR & AR).
- Cable, battery and device.
- Cables.
- Cables and wires.
- Can't see my keyboard.

APPENDIX: Literal Answers (Unsolved Problems, cont'd.)

- Clumpiness.
- Comfort and stigma attached to hardware - currently large, clunky, and you look like a dork. Also, quality of image/experience needs to equal at least that of HD/4K TV - at the moment it's a pay-off for 360 and movement.
- Comfort, friction, standalone VR.
- Comfortable and practical untethered headsets.
- Comfortable, natural-feeling and delightful interpersonal communication in VR.
- Complete immersion : force feedback, many sensors to manage virtual avatar, 3D free movements
- Complex devices
- Complexity of setup, price, and needs to be lighter/less wires, etc.
- Complicated controls
- Computer vision
- computing power
- computing power, screen resolution, portability, field of view
- Conformity of platforms and stitching isn't so great.
- Comfort.
- Considering inside-out is mostly resolved, I would say size of headset.
- consumer / home killer use case
- Consumer-ready Inside-out tracking for VR and how hands should really be like in VR (controller interface)
- Content.
- Controller occlusion with inside out tracking. It's the superior tracking method, but there's no good solution for tracking controllers yet. They all require the headset cameras to see the controllers.
- Convenience.
- Cords. We have too many and too bulky cords.
- Cost and expectation that this will have remotely similar use as mobile.
- Cost and lack of long-term engaging content.
- Cost of hardware, tethered HMD.
- Cost of high end devices to consumer market. But it is just a matter of time.
- Cost.
- Cost-effective, convenient, ubiquitous, wireless display technology.
- Costly equipment. Very few average people have access to VR hemets, controllers and 8-way treadmills
- Creating new UI and the lack of UI standardization we will need create libraries that people can use across different platforms that will interact with users in a predictable manner so people do not need to re-learn how to use each application.
- Creating untethered (wireless) VR experieces.
- Dealing with clients who have no clue about the technology
- Delivering the infinite virtual space experiences within a finite real space without sickness.
- Design: consumer trust. This IS a design problem. VR googles look like scary blindfolds with head vice straps. Why no outward facing screen on the front? Technology: Voice Recognition. Each of these devices should offer solid voice recognition as default control (and as a friendly assistant for all forms of confusion).
- Development and pipeline tooling
- Difficult setups, costly productions costs with not enough ROI. Headsets are bulky and uncomfortable, especially for women. High level to entry
- Display quality.
- Display quality: resolution & frame-rate
- Don't know
- Ease of access.

APPENDIX: Literal Answers (Unsolved Problems, cont'd.)

- Easy creation of content by users.
- Easy setup and distribution
- Encumbrance (heavy, uncomfortable, wires) Content
- Ergonomics
- Ergonomics, human interface, VR sickness, and more compelling apps.
- Eventually everything needs to be wireless, with longer lasting battery power.
- Eye fatigue
- Eye tracking
- Eye tracking
- Fast performance on thin clients ideally as simple as web browsers
- Field of View, graphics capability, and cordless, phoneless, all in one headgear
- For VR the moving component. But for all of these technologies I believe that movement, camera and confinement are the biggest issues
- For VR, motion sickness. For AR, FOV of optical see-through displays
- For VR... Inside-out tracking; of HMDs, body, and hands. For AR... Low-overhead environment tracking
- Form factor
- Form factor is too cumbersome
- FOV and quality content
- FOV is too narrow, especially in AR. AR has a LONG way to go.
- FOV is too small.
- FOV,
- Fragmented install base. Untethered inside out tracking that is cheap. Light Field displays can be printed vs. etched and enable massive FOVs.
- Full body tracking for all systems.
- Full body tracking, tactile feedback
- Getting binaural sound into experiences
- Getting our hands into the virtual world. Next is getting our feet and finally, locomotion.
- Getting the resolution to be more real life and up to speed with what our eyes/brains actually process to reduce latency and motion sickness problems.
- Getting them to work for people who wear glasses.
- Giving players more movement options such as, when analog stick is forward the player moves toward wherever they're looking always, or players can switch to other types of movement.
- Global movement, eye contact lenses, eye tracking, latency, graphic power, input devices, interaction lack, only visual senses, no: haptic, smell, tastes, audio
- Great VR resolution while losing the wire tether to a computer.
- Hand and body integration
- Haptic feedback and larger field of view
- Haptic feedback and locomotion.
- Haptic feedback for sure.
- Haptics
- Haptics
- Haptics
- Hardware is not handy/small enough
- Hardware not advanced enough yet: optics, latency issues, control.
- Having the big headset is a problem. Need to have almost a Moore's law type effect on the size of these devices.
- Head mounted displays are unwieldy and uncomfortable. The hardware needs to shrink considerably before AR/VR can really become useful outside of the niche market it currently serves.
- Headset design. Nobody wants to wear one.

APPENDIX: Literal Answers (Unsolved Problems, cont'd.)

- Headset is large and bulky
- Headset size
- Headset size & tethering; cost
- Headset size/comfort
- Headset tech needs to improve significantly.
- Headsets are still bulky, heavy, and tethered. Getting away from these design flaws effectively is the next step the VR industry is going to take.
- Heatsets are too cumbersome for mass adoption
- High def displays comparable to modern tv
- Higher resolution displays and simplified setup are two critical components that need to improve in order to achieve mainstream adoption.
- HMD friction
- HMD must be wireless, light weight, and adjustable (eye spacing).
- How can we use VR tech in multiplayer condition? next VR or AR tech must be something that could be used in public transportations.
- How to deal with nausea after prolonged use of VR.
- How to get mobile frame rates above 90 fps
- I believe VR is still not fit for long play sessions. The user can get physically tired much sooner than with conventional gaming.
- I don't have enough information to make this judgement.
- I don't know yet.
- I don't know.
- I don't think to have an answer for that
- I personally believe that a lack of integrated hardware is the biggest problem. Mobile headsets provide some solution, but having to run off the hardware of a PC is a huge barrier and alienates many potential users.
- I think more attention should be paid to what we can achieve with the hardware that is already out.
- In AR - form factor, it needs to get smaller.
- In AR, it's definitely UI's versus the 3D content overlaid on the real world. No one seems to have any idea how to solve a persistent, 2D UI being on screen at the same time as overlaid 3D content without the user's eyes going utterly cross-eyed.
- In game/app movement
- In VR it is a design problem centering around vection (the disconnect between visual motion and felt motion). There is a huge gap between the games people want to play and the games that are comfortable for most people to play. In AR/MR it is the technical problems around the optical technology; widening the FOV and reducing the form factor will be necessary for mass adoption.
- In VR, Movement.
- Industrial design and fitting the required compute within the available power/thermal budget.
- In-game locomotion
- Input & controls as well as motion sickness.
- Input devices/hand controllers which do not break the immersive experience
- Inside out environment and hands tracking on a pure headset based device.
- Inside out tracking for mobile VR, this is getting better. Most design relies on older mechanics (fast motion precise targeting) that current hardware does not support.
- Inside out tracking that is as good as Vive and Oculus tracking.
- Integrating other user virtual in the same experience
- Interaction language in VR (and AR) has yet to be defined in a consistent way. Having each app have a different way to teleport or move creates friction for users and raises barriers to getting more users
- Intuitive user experiences.

APPENDIX: Literal Answers (Unsolved Problems cont'd.)

- Isolation in VR, Unnatural and restricted User Input in AR
- It needs to get a lot less expensive and smaller/easier to wear with less hassle for setup.
- It's way too hard and takes too long to stand up a prototype, so it's hard to experiment and iterate. That's why so many VR experiences are essentially ports.
- Lack of care of audio - companies are rushing out to create VR versions of their games and haven't bothered to deal with audio as an investment. What is 3D immersion with graphics and sound is completely forgotten - you've expanded half of your core game senses.
- Lack of standards/interoperability.
- Larger FOV
- Latency, still.
- Lens distortion and peripheral vision.
- Light field tech in real time
- Lightweight 6 dof video
- Lightweight form factor for the average person
- Loading speed and storage capacity
- Locomotion
- Locomotion
- Locomotion
- Locomotion
- Locomotion
- Locomotion
- Locomotion and space. There should be a focus on making room-scale VR work in smaller spaces, and on making room-scale VR feel bigger.
- Locomotion in VR!
- Locomotion that feels natural, not just acceptable.
- Locomotion with VR spaces other then by teleporting
- Locomotion, wireless premium quality experiences, and proper AR tech.
- Mainstream acceptance via form factor and UX - too much focus on the 5% bleeding-edge or entry-level poor experiences which both cannot jump to mainstream as a result
- Making compact, chique-looking wearable tech in the MR field.
- Making content that is consistently rewarding and deep. Most experiences (gaming, cinematic or experiential) have little replay value and don't really take full potential of this new medium.
- Making games that expand outside of VR or AR demos, and are actually full fledged experiences. As of now, VR games are limited in scope.
- Making the headsets seamless to keep on and not a pain to put on over and over.
- Many problems have been solved, but not implemented evenly. Intuitive user interfaces, high resolution displays, and inside out tracking need to be implemented across all hardware and experiences.
- Marketing is the biggest problem. Once someone puts a headset on, they become brand champions. Getting more people into headsets - trying to explain the experience is the largest hurdle.
- Mass market form factor.
- Miniaturization, inside out tracking and high cost need to all be solved for this technology to become commonplace
- Mixed reality - calibrating the real world with the virtual.
- Mixed reality streaming (composite rendering) VR gameplay for games in Unreal.
- Mobile phone frame rates and natural interaction
- Mobile/Wireless tech that is powerful enough and at a high enough resolution to display content
- Mobility with proper inside-out tracking.
- Motion seekness
- Motion sickness

APPENDIX: Literal Answers (Unsolved Problems, cont'd.)

- Motion sickness
- Motion sickness and any issues with those who dont have 20/20 vision
- Motion sickness and locomotion (VR); limited field of view, resolution and latency (AR)
- Motion sickness when larger movements in the scene don't match the movement of the user's body
- Motion sickness!
- Motion sickness, even though this is not a problem for AR and even VR games are reducing motion sickness by design
- Motion sickness.
- Motion tracking and cables
- Motion. We seem to be ham strung by people who get sick if they move themselves. I am not one of those and am frustrated with the current movement solutions for first person games. I play Ethan Carter in VR, which has the regular WASD controls and I love it.
- Movability of the user
- Movement
- Movement
- Movement mechanics are a big one, but there are already many solid solutions out there.
- Movement, haptics, resolution.
- Movement... something we solve with ACTUAL player motion instead of teleportation etc. etc.
- Movement/nausea
- Multiplayer
- n/a
- NA
- Navigating the space - Walking/Using a Controller. There are still challenges and it still does not feel like you are walking in real life... it's very difficult not to bump into things, not feel nauseous after long periods of time, and feel autonomous in your movements.
- None
- None.
- Not sure
- Not Sure
- Not sure
- Open ecosystem
- Operation
- Optimization for low end hardware (particularly mobile VR experiences)
- Perception that it creates motion sickness
- Performance constraints limiting quality
- Peripheral needs to be increased
- Personally, I think it's two things: 1) the lack of solid wireless headsets; and 2) the cost of goods. It takes almost $2,000 just for the PC required to run high caliber games on the Rift or the Vive, PLUS another $800 for the vive, or $600 for the Rift/touch package. Right now, it's NOWHERE near the price point it needs to be in order to bring VR to the masses.
- Physical immersion in a VR world, being able to reach out and feel like you have grabbed a virtual object
- Pixelation is still very noticeable in most hardware. The current necessity of cables to support the needed bandwidth for most platforms. Both of which I am sure will get solved in the near future
- Portability, look and feel, and incentives to replace phones and laptops
- Positional tracking and hand gestures
- Power and heat and capability of standalone hardware without a dedicated PC
- Power consumption, overheating
- Power consumption, proper screens, latency.
- Practical mobile inside out tracking for room scale.

APPENDIX: Literal Answers (Unsolved Problems, cont'd.)

- Preventing VR trolling
- Price
- Price.
- Prices of some of the better VR tech definitely limits the market currently. Also being kind limited to a one room feel in design is something we must overcome.
- Privacy systems
- Processing and battery power
- Producing the detail we are used to in our games
- Quality content and prices
- Quality of screens.
- Reading text/resolution is not quite there yet. Peripheral vision is limited, barn door/horse blinder effect.
- Real world interactions - anticipated or not.
- Realistic, full-body avatars that are not cartoons.
- Real-time re-lighting of rendered objects in a real environment
- Real-Time Rendering with high polygons 3D. For VR, Seing the feet or other body parts
- Reducing the size of the gears.
- Relation with synchronization of real time vs VR application time
- Reliance on other devices (PCs, smartphones)
- Removing motion sickness and discomfort.
- Resolution of the displays.
- Screen resolutions are stil poor.
- Seamless use of multiple displays.
- Sensorless tracking. AR image quality and brightness.
- Settling in on a broad range of game genres that work well in VR. Getting the cost low enough for mass consumption.
- Shared Experiences
- Shared experiences. Currently, it is isolating.
- Simulation sickness - technically unsolvable for 100% of audiences
- Simulator Sickness and its associate to VR
- Solid 360 interactions
- Solid inside out tracking
- Standardization
- Still display.
- Still too difficult to create, too much coding experience necessary.
- Strapping a big device to your head.
- Streamlining the VR headsets in weight, bulkiness, and wires.
- Tactile feedback.
- Technologically i would say, the wires and phisical attachement of user to pc.
- Technology: Eye strain which prevents long sessions Design: Design that merits longer play sessions
- Tether / battery. Outdoor / Day-to-day adoption.
- Tethered, high end VR. Folks are working on it however there is still no "official tech. If we can solve the "wired" issue then many of the other annoying issues may go away as well.
- Tethering and form factor
- The biggest issue is definitely the lack of available "simulator sickness" mitigation techniques. Since each VR application offers a unique user experience, no one mitigation technique can service all applications. Future designs must consider the medium/genre they are developing for and continue to investigate new mitigation techniques to ensure optimal user enjoyment.
- The biggest problem is audio and motion blurring/sickness..

APPENDIX: Literal Answers (Unsolved Problems, cont'd.)

- The biggest technological problem with VR, AR or mixed reality at the moment would be the fact that it requires a dedicated space to be used effectively. I speak specifically of the HTC vive, as not everyone can afford a dedicated VR room. Research into the field of EMG data classification for dexterous control of prosthetics can be extended to cater to the needs of VR. This could potentially solve this technical issue and open up a whole new set of possibilities.
- The cost needs to come down significantly in order for larger adoption for the consumer markets. Hopefully the stand-alone headsets (like the Google + HTC) product will help solve this.
- The cost of getting the full VR/AR experience is nowhere near affordable
- The friction of turning on a VR / AR experience
- The gap between mobile VR/AR headsets (that are cheap but weak and have bad/no tracking) and desktop-based solutions (that are powerful and realistic, but tethered and expensive)
- The HMDs are currently too expensive and too daunting to own. They are also too much of a pain in the ass to use.
- The isolation of the user makes it difficult to use in many circumstances.
- The must have app to drive adoption of VR
- The price of the High end hardware. International availability.
- The realtion between cost and the processing power needed to drive high resolution displays. Once it lowers VR/AR will become ubiquitous. 5 to 7 year estimate on the current market.
- The tether to the computer and screen resolution.
- The tools are created thinking that the creators of most of the experiences are going to be developers when most of them are going to be designers, architects, animators, students, or really anything else. The tools should be built around helping people like this create interactions and combining objects, textures, and lighting from diverse sources. You can create quite a bit in Unity or Unreal without being a programmer, but they can go much further in making creation tools that are easily used.
- There are many.
- There are some.. But all are getting solved very fast
- There's a tradeoff between standalone headsets with lower fidelity and tethered high power headsets. The holy grail is a high-powered, low-latency, high resolution, un-tethered, lightweight, motion-tracking headset.
- There's no instructions on how to consume this technology for the consumers who would purchase it. What is the standard? Who dictates that? What is the target? What's the minimum? How is it supposed to be? Who cares, and why? Who benefits? How much will they pay for this? Are you supposed to experience all this in a haptic feedback suit with motion sensors? Or are you just fine with your Google Cardboard viewer? Is it better to pay for a better version of VR/AR? Where is all this leading to? What's in it for me to invest or adopt? Is it better to wait until the technology is better or indulge now? What makes a good VR/AR game or marketing solution or application? Who decides? Who curates them? What do I do when I get motion sick? Why do I need to even have that concern? ETC. The biggest design problem is that there is not a tangible consumer-facing paradigm instructing them how to consume! Most people don't even know what it is or why they should care, and until VAM-R has its "Cosmopolitan Magazine" and "Ellen DeGeneres Show", there won't be a market of Wal Mart customers in line on black friday to purchase what they were told to purchase! To them, it's all hot steam, because no one is freezing it into ice cubes money-having consumers can put in their drink on a Friday evening.
- They are different experiences, I believe that each has it's specific unsolved technology or design problem. For Virtual reality I would say the proper tracking of whole body movements.
- To make a low price untethered VR device that performs as well as the Vive.
- Too clumsy HMDs.
- Too many to list; lighter, faster, wireless, etc
- Too many walled gardens, platforms need to play together better
- Too many wires
- Tossup between AR/MR FOV for full presence and AR/MR object recognition
- Tracking and resolution
- Tracking, resolution
- Transferability. Practicality.

APPENDIX: Literal Answers (Unsolved Problems, cont'd.)

- True inside-out tracking that works in broad daylight
- UI design, especially how to enter text
- Univeral usage for computer hardware components
- Unshackling from taxed-flow model cloud based social media business models that disempower the user and seek to create ecosystems that dumb down content.
- Untethered and performance framerate
- Untethered devices with high quality / power supply
- Untethered, Higher bandwidth, Haptics
- Unthered HD VR hardware with adequate battery life.
- User experience
- User input
- User-friendly teleportation; comfortable and efficient text input; controllerless, hands-first interactions
- Using gloves instead of controllers would help the player
- UX! it's definitely the UX. Developers are inheriting 2D problems and interfaces are still not paradigm-shifting.
- Ventilation, and resolution.
- VR - reduce time/cost of high quality stereoscopic sticking
- VR sickness
- VR: What does a long term, compelling, user experience look like, and how do you get the user to interact with it comfortably and meaningfully AR: Displaying AR at a sensible price with decent object tracking and contrast. Camera systems and wave guides are expensive yo.
- Walking experience, especially in Virtual Reality...
- Walking/running mechanics.
- Way to many bugs in every piece of hardware, software and no standards.
- We need more bandwidth from humans into the machines in order to allow people to do real work and have relevant social interactions.
- What is it for? What customer need is being solved?
- Wide-FOV AR displays
- Wireless connectivity and improved smartphone battery life/operation
- Wireless headset that is much lighter than the current ones
- Wireless VR!
- Wireless VR, also keeping user orientation in chaperoned environments
- Wireless VR, increasing frame rate
- Wireless, comfort.
- Wireless, light, comfortable headsets that are as easy to put on/off as regular glasses
- Wires
- Wires
- Wires
- Wires for VR. FOV for AR.
- Wires! they kill the immersive experience of user.
- Wires, tracking points, and hardware cost. Hopefully Google will be addressing this with their upcoming VR initiative with HTC & Qualcomm.
- Woah. this is a big one. Well the biggest problem is the cost of the hardware and the current limitations. Soon as you can fit a Vive or Rift into your purse, things will change - and get the cost down to reason. Then there is the workflow and challenges of production. We need more 360-ready phones - come on Facebook!! Build a phone and get that content directly. I think in terms of CG content that will become a specialized skillset and we will need to see code get more accessible for the visually oriented designers and creators. Legit applications will need good eyetracking solutions to provide stronger feedback to developers in terms of usability and metrics.
- You are either bound to a chair or semi-free in the VR world Controllers are only a temporary solution to the problem of interaction in VR

APPENDIX: Literal Answers (cont'd.)

What games or apps do you think have best used VR, AR, or mixed reality in the last year? What particular aspect did you appreciate the most?

- The Invisible Hours (Tequilaworks) is the best VR experience up to date, it had the best gameplay and story. Rick and Morty: VR did a fantastic job demosntrating new immersion techniques on non photorealistic environments, and some good VR-only mechanics.
- "Cool!" uses immersion to reduce pain better than drugs.
- "The Playroom VR" from SIE Japan Studio. VR games can be a party experience!!
- "The Void" theme park. I really like the MR approach, some senses in the VR realm, while others remain in the physical.
- ...Google 3D VR App for YouTube!
- 1st person perspective makes someone feel more connected to a game
- 3D text in VR, people who actually tried to make use of the actual space rather than flat UI menus I would use on a 2D screen.
- Abbot's Book demo on Vive is my favorite immersion experience. Batman VR's end sequence in the cell is inventive and satisfying.
- Accounting, it made me feel bad for taking certain actions in the game, showing the powerful immersive effect.
- Accounting, Rick and Morty — they know what delights VR players and focuses on the platform
- Along Together; interaction between the character and the player, and camera movement
- Any VR/AR games with multiplayer are the most interesting to me because of that sense of connection. Online multiplayer with VR/AR is the next step in that industry's evolution.
- Anyland fully takes advantage of VR for the purpose of social worldbuilding. Very nice use of the hand controllers.
- Anything by Felix & Paul when it comes to 360 video. They're the clear market leaders in that space. I also love the Fantastic Beasts experience by Framestore as a good example of mixing photorealistic stereo panoramas with game engine elements on a mobile platform like DayDream. For high-end/ desktop VR platforms I think content creation apps like Tilt Brush and Medium reign supreme.
- AR: Pokemon Go, it made sense and was an experience that only really made sense with AR. VR: Job Simulator was a good push in the direction for the type of titles we should be focusing on.
- AR: Zombie Run VR: With google daydream taking pictures and looking at them in VR
- Arcade experiences, serious apps (3D sketching and sculpting), narrative (interactive or passive) experiences
- Arizona Sunshine
- Arizona Sunshine, Pokemon Go, Walking Dead (starVR)
- Arizona Sunshine, Rick n Morty VR Adventure, Eagle Flight, Job Simulator, The Unspoken, Robo Recall, Altspace VR/High Fidelity, Rec Room, Sports Bar VR, New Retro Arcade VR, Bigscreen. All of these provided a level of immersion, and attention to experience, that promoted the most positive aspects of VR. In the case of titles like Altspace, High Fidelity, Rec Room, Bigscreen, and Sports Bar, the social features enabled interaction, blasting away the popular notion that the VR experience is isolating.
- Arizona Sunshine. Great gameplay and storytelling combined, it's a winner.
- As I mentioned, I am very interested in developing for and playing in VR, but I can't afford the hardware. Well told first person narratives and adventures are what I'm interested in. One of these that really caught my eye was Wilson's Heart. I've not played it, but it looks amazing. That kind of game is what will really drive VR to the holy grail of the "holodeck". Also, it's hard to deny that Pokemon Go did a lot for mixed reality, in terms of making it accepted and endemic, even if players were not aware of the terms AR or MR.
- Batman Arkham
- Batman Arkham VR, the PSVR bundle
- Batman Arkham. The realism of the experience.
- Biased as I work for a development company. I think our Vimy Ridge World War Battle that we created for a museum was pretty great.

APPENDIX: Literal Answers (Best VR/AR/MR Uses, cont'd.)

- Bigscreen
- BrinkVR. Environments are impeccable and really contributes to heightened emersion.
- Budget Cuts, Job Simulator, Rick & Morty. They are all making good use of VR by designing specifically for the affordances of the medium.
- By recording and sharing your voice as you sing, Singstar had a great method for making the game social. That is extraordinarily important in VR, as it is inherently isolating.
- Can't name any right now.
- Carne y Arena - a VR installation showing at Cannes and the Prada Museum. Powerful story that can only be experienced in VR.
- Commercial success: Pokemon Go Generally, advertisers create great content. Followed by TV and film trailers and short pieces.
- Conical studios work.
- Cryteks Robinson's Journey and The Climb. Very good controls, very good leading through the game
- Dear Angelica, SuperHot, Notes on Blindness
- Don't have a favorite
- Don't know
- DriveClub on PSVR, because of the quality and no motion sickness on a speed moving environment.
- Eclipse of Light. I appreciate that this is a full game and breaks from the 'short experiences' that the VR industry is notorious for.
- Elite Dangerous has probably the most immersive experience
- Elite Dangerous. Probably the most immersive VR experience out there.
- Embarrassingly enough, the best almost-market implementation of AR/MR this past year was Snap, Inc. when they delivered their Spectacles in a very Willy Wonka manner. While they certainly weren't any milestone as a product, they were at least delivered to a "beta market" as if they were meant to be one. Google's Daydream headset had at least aesthetics and design in mind, but it was no more than just another entry-level VR viewer for an app/development market which looks more like a backstage rehearsal than a grand performance worth the ticket cost. Real Estate AR apps put the best functionality and practicality into the tech, and I think its relative ease of implementation given the desired results (copy pasting furniture into a room), it will have the best combination of "hey that's cool, and it's actually helpful!" to help bring these technologies to a viable state within the market.
- EVE Gunjack
- EVE Valkyrie. Highest quality of visual experience. Very lacking in regard to combating motion sickness though
- Everest (VR)
- EverestVR for medium language exploration, Job Simulator for innovations, tiltbrush/quill for disruption
- Facebook's social VR platform. The UX is well-thought-out, and the avatars felt quite natural.
- Fan of Microsofts work around the Hololens, especially non-gaming contexts.
- Fantastic Contraption and Job Simulator continue to be my favorites from a UI design standpoint.
- Farpoint. Great controller
- First Impact: Rise of a Hero. First open world superhero game in VR that engages the player in many ways!
- Firstly, the best VR experience app must be Eagle Flight.
- Fist of Physics, placed me in a world that seemed very viscerally real.
- For VR I'd say Google Earth VR as number one by far since the immersion depicts VR at its best (right now). As for AR or MR nothing really stood out, honestly.
- Gabsee AR is an interesting use of visual SLAM for compositing animated characters into the user's environment.
- GabSee. Social leverages existing social platforms.
- Games have made some powerful experiences (Raw Data comes to mind).
- Games like I Expect You To Die and SteamVR's The Lab are best for most people to pick up and play.
- Games such as "Call of the Starseed" and "Everest" had large physical components that really transported the participants into their respective story worlds.

APPENDIX: Literal Answers (Best VR/AR/MR Uses, cont'd.)

- Games with just VR experiences, with very minor gameplay.
- Gaming and entertainment has huge potential - only just scratching the surface. Sports is a no-brainer - even better once you can make it social.
- Google Earth and A Chair in a Room Greenwater. Google Earth is mindblowing for virtual tourism, and A Chair in a Room felt like a proper non-gimmicky VR game.
- Google Earth VR
- Google Earth VR and Google Street View VR. Simple, immediately appealing, and the best experiences it creates are not insular but are about talking with people in the room while using it. Try this some time: Put someone in street view of their childhood home and just let them walk around and talk.
- Google Earth VR has been the most compelling way to demonstrate to users the awe and practical use of VR
- Google Earth VR is great, MakeVR is an exciting concept that could use a little more work
- Google Earth VR which I have used as a tool for real world solutions. Social VR apps allowing me to have educational and social experiences. Big Screen allowing me to work from remote locations.
- Google Earth VR, for its ease of use and obvious improvement over non-VR version.
- Google Earth VR, I Expect You to Die
- Google Earth VR, The Lab, Tilt Brush
- Google Earth VR. Incredible new way to look at map data.
- Google Earth VR. Many people I have given demos to enjoy being able to explore our world this way.
- Google Earth, The Unspoken, Quill, Dragon Front and Bigscreen all impressed. Just breaking out of the "roller coasters and skydiving" stereotype is a great place to start and these applications did a good job of showing what else is both possible, fun and useful in VR!
- Google Earth. It's very thoughtfully made
- Google Tilt Brush. You can paint anything anywhere in 3D!
- Google Tilt Brush and Oculus Quill. Allows for creativity and expression in VR
- Google tiltBrush.
- Hard Target - Playing with time MageWorks - Creative 3D object creation Audio Shield - Utilizing unique VR gameplay Big Screen - Constantly adding new and useful features
- Haven't tried any.
- Healthcare, marketing, collaborative apps
- Hololens with Holoanatomy. Solid experience that can be used over and over. High replay. Valid for multiple departments.
- I absolutely love the HTC Vive's Tiltbrush, still going strong as the most impressive thing yet
- I am honestly can't remember what was released when at this point, but my personal favorite is probably Oculus Medium... even though it still falls short of what I want, being able to directly build an environment around yourself is amazing.
- i do not work with games.
- I don't know.
- I Expect You To Die, because of the high level of interactivity with the environment.
- I hate to say it but Pokemon Go, it really made it easy for people to understand AR. NYT VR is also very good and provides an easy explanation for what could be.
- I have been out of the loop on current releases for VR, but I feel that the Horror genre has a huge amount of potential.
- I have many that I have liked, but nothing that stands out as being the best. Coming from the UX side of things, I see most apps as being too heavily drawing from gaming as inspiration, when architecture and physical design are much better inspirations for what interfaces and interactions should look like.
- I have to say Robo Recall and Batman Arkham VR. Even though they are simple/shallow games, the amount of polish and great visuals shows a glimpse of what future games can be.
- I liked Spaced Pirate Trainer, it's a fun game that fit very well for the HTC VIVE. The slow time mechanics work great with the hardware.
- I loved Tilt Brush when first discovering that.

APPENDIX: Literal Answers (Best VR/AR/MR Uses, cont'd.)

- I really liked Pitch Hit VR for using super familiar physics and settings to make a fun day at the ballpark
- I think experiential based products work the best for VR right now. Without the mass adoption at the consumer level, it's hard for game companies to produce user-end experiences at a high level without incurring debt that could possibly never be recouped. Client-based development has been the best track for us.
- I think Quill, Medium, and Tiltbrush are by far the most interesting and relatively mature VR products.
- I'm way behind on playing VR games, so until I get some time to really sit down with them, I haven't a good answer.
- Immersive First Person Experience in Games or Apps
- Immersive titles like Call of the Starseed. Losing oneself in VR.
- In VR... Tiltbrush, Google Earth, and (to be totally candid) our free-roam/warehouse-scale multi-person wireless VR experiences. I haven't seen anything in AR yet that's worth mentioning.
- Irrational Exuberance.
- It seems like Owlchemy Labs' Job Simulator and their re-skin for Rick and Morty have been the largest success thus far. They really focused on the strengths of VR: being able to reach out and influence the environment around you.
- I've not been impressed with anything.
- Job Sim, Rick & Morty, Raw Data, Star Trek BC, Arizona Sunshine
- Job Simulation and Robo Rally do a good job of placing you in the world and giving you interesting things to do. Gary the Gull and Invasion do a good job of placing you in the world and making you part of a story.
- Job Simulator I liked accessibility and fun
- Job Simulator has best used VR. The interaction and feedback is great.
- Job Simulator is the gold standard of what I think the potential of VR is
- Job Simulator, Google Earth, Mission ISS, Medium. Interface quality and interaction design well conceived for VR in each
- Job Simulator, Google maps, ... not a lot yet. Most implementations have been proofs of concept. I want to see a social VR / AR experience that creates a productive interaction with someone else in which we can collaborate on a virtual whiteboard, notepad, etc.
- Job Simulator, I appreciate how it didn't try to get detailed allowing it to overcome many barriers in terms of computer power
- Job Simulator. It was clever and didn't feel like a tech demo. It didn't suffer from a "pretty good for VR, please forgive our lack of sophistication" syndrome.
- Job Simulator. It's an experience that can't be had in a non VR game. Tilt brush is another example of an experience that works in VR only.
- Job Simulator; no camera motion other than the person itself, which makes sickness less of an issue.
- Job Simulator's interaction model
- Keep Talking and Nobody Explodes, I liked the interaction between players, It's unique and serves as a good party game and introduction to VR.
- Keep Talking and Nobody Explodes, is a great use of VR with shared social screen. I like that it gives a purpose to the VR set while including others in the room. Brilliant.
- Lands End, Super Hot, The Blu, Gnomes and Goblins. Ability to take you to a new world and explore. Next will be stories told in these environments.
- Loved Adrift. seemed real.
- Lowe's app on Google Tango, Amazon
- Masterpiece VR
- Medical
- Medical, Pleasure, Home Improvements, Vacation Spots
- Medium
- Merge Cube
- Merge Cube, Tilt Brush

APPENDIX: Literal Answers (Best VR/AR/MR Uses, cont'd.)

- Meta's Brain Anatomy. It's very immersive visualization by AR, but also promising contents for industry.
- MindeskVR design creation in VR
- Minecraft VR, Rec Room
- Mixed Reality - The Void, GlobalSim simulators Elite Dangerous (VR) - VR really enhances the experience. (Other flight sims - DCS, IL-2, are also great, but the experience isn't quite as refined). The Wave VR: Woah. Some weird, wild innovation to take advantage of VR as a social medium when combined with music.
- Music visualizations, immersive digital media arts related experience, social media interaction, and AI training
- My favourites are Job Simulator, Rick and Morty, Star Trek: Bridge Crew and Robo Recall. All of these apps let the user interact with their environment extensively. This allows for much more immersion in my opinion.
- n/a
- n/a
- N/A after talking to multiple people and companies, people just want to jump on the VR bandwagon without understanding why or how it actually improves and experience. Saying that something is more immersive is not a good enough reason for it to be in VR. I have yet to be impressed by anything in terms of content.
- na
- NA
- No comment.
- None
- None it's good as it is i guess
- Not sure.
- Not sure.
- Not sure.
- Not sure.
- Not sure.
- Notes on Blindness is an amazing experience that helps to illustrate concepts and experiences that would be hard to convey in another medium. It's an excellent and deep experience, however relatively short it may be.
- Old Friend b/c you don't feel like you have to do something, you don't worry about figuring it out, and its just fun VR. Google Earth - Feels like the future. Pokemon Go for obvious reasons in AR.
- On the UX side, Epic Game's Robo Recall demonstrated an exceptional mastery of improving user enjoyment and ease of operation during gameplay. Having the player reload by grabbing new guns at either side of their waists emulates the emergent and exciting interactions of Hollywood Western and action standoffs that really immerse the player in their role. HTC's Tilt Brush alternatively introduced an impressive foundation for creating immersive artistic experiences within VR space. Using the full world's coordinates to create visually dynamic creations presents greater interactive and limitless opportunities to create without bounds.
- One of my favorite projects from this last year was the Virtual Reality Album created by the musician Hot Sugar. Being able to interact with the world to create the music in different ways was quite genius.
- Onward, Tiltbrush, Medium, Thumper, EVE: Valkyrie
- Onward. Your body / toolbelt is used to access inventory
- Our GearVR free-roam VR demo with haptic feedback weapons.
- Owlchemy's Rick and Morty game. SuperhotVR. Both really play with physical interaction.
- Paranormal activity is great example on how emotions get multiplied in VR. Also Superhot and Robo Recall are great examples, but all games very short to play.
- PC First-person shooters (i.e. Valve)
- Penrose Studios is doing very pretty proof-of-concept work in teaching viewers how to interact with the medium.

APPENDIX: Literal Answers (Best VR/AR/MR Uses, cont'd.)

- Personally, non-gaming.. training, education, med-tech, and simulation.
- Playstation VR demo games, Batman Arkkham, Superhot - these are all uniquely VR
- Pokemon Go did good with public and opening eyes, but fake AR, Facebook and Snap have opened up to the public to see it which will open more doors in real AR, that Pepsi bus stop ad was by far the best out-facing content to really wow the public who saw it.
- Pokemon GO
- Pokemon GO
- Pokemon Go - market penetration, media coverage, value-driven sustainability
- Pokemon Go was actually great because it took advantage of a variety of different groups (Pokemon fans, geocachers, "outside" individuals). Visually it wasn't stunning, nor was it compelling plot-wise, but it marketed itself excellently
- Pokemon Go, I think it was accessibility related. Everyone knows the pokemon narrative and it was fun and quick to participate.
- Pokemon Go, Ingress, and some of the horror games (i.e. Resident Evil 7) have really been the best at immersion for the platform(s).
- Pokemon GO
- Power Solitaire VR, it breaks the mold for casual VR games
- Psychonauts VR game did a great job of working a teleport based navigation mechanic into the game in a controlled but consistent way.
- Puzzle games in general seems to be very well suited for VR, AR or mixed reality.
- Raw Data (VR), Lucky's Tale (VR), Kodon (VR), Medium (VR), Audioshield (VR) & many others
- Raw Data and Sprint Vector. I think Survios has really led the charge in finding how to best move around in a small space. With the programming of Sprint Vector and the graphics/gameplay of Raw Data, they've shown that AAA-caliber VR games are definitely a reality and possible.
- Raw Data is a great game that feels very immersive and intense.
- RE7
- RE7 was very impressive. It used the VR just for the immersion and not for controls; controls were still controller bound. Some VR products try to incorporate VR controls in with the actual VR, and while some instances of this work, a lot don't work very well and leave the game less enjoyable to play. I think the only solution to this problem is time to better develop the technology until companies can release fully immersive systems that work well and are affordable.
- Really enjoyed Vanishing Realms. Immersion was very good.
- Really enjoying Google Maps in VR as it pertains closely to my industry.
- Really like use of the tech to control drone flight by projecting user right into the aircraft.
- Rec Room (UI, community), Robo Recall (polish, UI)
- Rec Room has done an excellent job with creating a fun social VR experience. Bigscreen makes it more efficient to work with remote teams in VR than through any other available technology.
- Rec Room is a pretty cool use of VR for a social experience.
- Rec Room
- Resident Evil 7 — first AAA experience in VR.
- Resident evil 7, it breathed new life into a stale franchise and created an experience that while can be done without VR it is definitely be better with VR
- Resident Evil 7. It's very atmospheric, bit slower phase and those helps it work well in VR. First game which I rather play with VR than regular screen.
- Resident Evil VII, Star Wars Battefront X-wing VR Mission, Farpoint. The aim controller for Farpoint really made the title more immersive.
- Resident Evil, PSVR (price), Vive with no wires
- Rick & Morty - focused on the entertainment and brand rather than just being a glorified tech demo
- Rick and Morty: Virtual Rick-ality they develop a solid entertaining experience that allows you to forget about the headset you are wearing

APPENDIX: Literal Answers (Best VR/AR/MR Uses, cont'd.)

- Right there, you ask what games and apps - don't box XR into just games and apps. This is not mobile. This is not desktop. What about all the creative pieces like from oculus story, baobab and marshmallow laser feast and F&P?! I think the Felix & Paul piece they did with Obama on Yellowstone was special, I liked all the work from Oculus Story's team, Penrose rocked, and my favorite was Pearl from the ATAP team at Google. Please, open the realm beyond just games and apps, that is partly what's wrong with this industry now, it's trying to be something everyone can get their head around and it's not that. It's much much more epic.
- Robinson the Journey -> High quality content
- Robo Recall - Interaction design
- Robo Recall (natural use of teleportation, polished game) and B2B applications for real estate worked out great for us this year.
- Robo Recall : excellent shooting game without motion seekness
- Robo Recall and Arizona Sunshine have been the best. The reason being that they bring a more whole game experience into one package then most VR game so far. They provide a narrative driven experience that consumers are more accustomed to then the brief experiences that VR game have typically been.
- Robo Recall and Superhot. Interaction in VR is the primary focus at the moment!
- Robo Recall demonstrated some of the current best practices in VR game design. I appreciated the attention to detail in guiding the user through the experience.
- Robo Recall harnesses the physicality of VR in a truly satisfying way. I also like the comfortable locomotion in Climbey. Statik is a lovely puzzler that requires observation of the environment.
- Robo Recall is by far the best VR experience of all time. I haven't been that impressed with anything else.
- Robo Recall, excellent interactive game play and visual quality.
- Robo Recall, for it's commitment to delivering real AAA polish in a VR space.
- Robo Recall, Header Goal VR
- Robo Recall, its the first triple A quality title I have seen released on VR. But they messed up bad by releasing only on the Oculas.
- Robo Recall. I appreciate to shoot bot without motion seekness
- Robo Recall. It had a real budget, and good developers to make something awesome. Good content exists, but publishers are afraid to fund due to limited market share penetration.
- Robo Recall is great
- Short games or experiences.
- Simulation (i.e. flight)
- So far real estate has the best use.
- Social interactions
- Sound Boxing (punching to music is a super fun, novel, experience). Tilt Brush (shows potential of VR productivity tools). VirZOOM (shows potential for VR fitness).
- Space Pirate Trainer - arcade experience, use of natural motion as part of game design. Job Simulator - rich interaction with the environment.
- Space Pirate Trainer was one of the first VR experiences I had and it remains one of my favorites. Reaching to my back to swap gear, the environment- everything was well put together which made it an immersive experience
- Space Simulation, driving games.
- Star Trek Bridge Crew - Immersive, challenging and Social
- Star Trek: The Bridge - multiplayer VR game with cross functional support between PSVR, Vive, and Rift. It is very cool to team up with 3 other people to complete missions together.
- Still looking for killer app
- SUPERHOT
- Superhot - game play mechanics Robo Recall - finish and immersion I Expect You To Die - cooperation (VR/non VR)

APPENDIX: Literal Answers (Best VR/AR/MR Uses, cont'd.)

- super hot, job sim, rock band VR full 3d experiences that allow room for player choice and creativity
- Superhot
- Superhot - puts you in the center of the action. Audioshield - instantly fun and shareable with friends. Longbow - focus on realistic haptics with simple funny graphics. Proves a lot of the immersive power of VR.
- Superhot makes fantastic use of a roomscale setup (whole body movement)
- Superhot VR - great way to get folks to move around and appreciate roomscale Obduction (despite bugs) - high quality entirely synthetic experience Recent HoloLens / Meta environment demos - not just Pokemon Go, but what can you really do with a mixed environment, and how to survive the scarce / expensive phase by leveraging enterprise
- Superhot VR (immersion), Unseen Diplomacy (locomotion/use of space),
- SUPERHOT VR has managed to design its entire game around a limited playspace.
- Superhot VR, Robo Recall
- Superhot VR, Tilt Brush, Oculus Medium, Budget Cuts, The Lab, Audioshield. All make fantastic use of room scale and are apps that can only work effectively in virtual reality.
- Superhot VR, use of space and player physicality, Call of the Starseed, great visual quality and narrative,
- Superhot VR. Played to the current strengths
- SUPERHOT! The way to utilize player movement is a prime example in that game.
- Superhot. Great gameplay and easy for new players to jump in.
- SuperhotVR (dynamic movement & novel gameplay) DefenseGridVR (replayability), Valve's "the Lab" experiences that show the range of VR
- sword art online (anime)
- The Journey Playstation this is a good interactive game!
- the 'Kept' demo by S1T2 in Sydney. Lovely graphics and unique mechanics
- The Lab
- The Lab (Valve) The feel is good when your favorite game - Portal - jumped to VR and it's immersive. But too short
- The Lab — best intro to room-scale VR because it uses your body and eases you into the controls. Google Earth - amazing product evolution Pokemon GO - captured mass attention, put AR in minds of people who had not used the tech before Rec Room - well executed multiplayer gameplay
- The Lab is still the best all around example of VR's capability and potential hands down.
- The Lab, and the Rick & Morty game. The attention to detail is amazing!
- The Lab, Cosmic Trip, Zen Blade/Fruit Ninja, Audio Shield. All of these had very beautiful and/or simple controls that always felt like an extension of the user.
- The Lab: This really did a fantastic job of showing the brave new world of interaction that VR presents Quill: This one allowed for pro level creation entirely in VR and allowed you to experience your creations in a unique way while offering more control than any VR creations apps had up to that point. Google Earth: This showed the possibilities of education in terms of travel and also how powerful nostalgia is when mixed with presence. Everyone immediately once to go see the place they grew up.
- The SteamVR calibration app - due to the HTC Vive tracking, reality was dead on. DEAD ON. This is unbelievably important, and not a lot of credit is given here. I spent my unemployment money on a headset when I reached out for the controllers, and they were RIGHT THERE.
- The two games which stood out in my opinion are Rick and Morty: Virtual Rick-ality and Cardboard Crash(for Google cardboard). I'm a huge fan of owlchemy labs' work and Rick and Morty: VR was just phenomenal. It really maximized the capabilities of the Vive at the moment without compromising the quality that's expected of the Rick and Morty tagline. The same can't be said about the other Rick and Morty games like Pocket Mortys, which seemed like a joke that was extended for too long. Again, this is just my opinion. I'm a huge fan of educational games and I believe that they could serve as a bridge between non-gamers and gamers. As it doesn't fall under the blanket belief that "games are for kids", they cater to a much larger audience than traditional games. Cardboard Crash by Vincent McCurley is a virtual reality tour which brings to light the ethical ramifications of implementing a self driving car. The overall presentation was phenomenal but what stood out was the fact that it incorporated VR to allow the user to experience the scenario in question and then decide how it should be handled. This made it a grade A educational game in my opinion.

APPENDIX: Literal Answers (Best VR/AR/MR Uses, cont'd.)

- The Unspoken made excellent use of the technology, player input, and movement (teleport)
- The VOID has the best experience so far.
- There are few great games on PSVR (Farpoint, Resident Evil VII). I also like our game for GearVR - SAMMY in VR.
- There was a shooting game that was included in Oculus Rift. Can't remember the name of it but it reminded me of the movie iRobot. I would say that this game was and is the perfect game to describe how VR experience should be.
- Tilt Brush
- Tilt Brush
- Tilt Brush
- Tilt Brush
- Tilt Brush - a breakout experience
- Tilt Brush - a new way to interact with art. RacketNX - virtual interactive sports.
- Tilt Brush - Easy to go in and paint Google Earth VR - Builds upon foundation that is Google Earth and enhances it Robo Recall - AAA game production values but made free for anyone with Touch controllers (gives incentive to buy them) Medium - See Tilt Brush and Robo Recall
- Tilt Brush - full fledged art creation tool Star Trek - social VR Eagle Flight - fast comfortable locomotion Rick & Morty - super polished playground experience Fantastic Contraption - mixed reality trailer The Lab (Archery) - Visceral fun
- Tilt Brush (VR) - has delivered meaningful updates repeatedly, and is genuinely useful for new forms of concept art, and deliverable video, in my job. Valve's "The Lab"(VR) - is still my go to for 1st timer demos. Variety of well designed mini experiences on a table, immediately. Unreal's "Robot Recall" (VR) - seems to set the high bar for visuals and feeling like a real game. Gunfire Games "From Other Suns" (VR) - impressed me with it's options for moving around. (seemless transition from first person teleporting to third person camera snapping and first person sliding). Survios "Raw Data" - delivered first person sliding as an aspect of combat. proved the concept.
- Tilt Brush and Google Earth VR are two of the best and most useful experiences. Unlike most VR experiences that are glorified tech demos, these two apps are genuinely engaging and interesting.
- Tilt Brush does a fantastic job of introducing users to the VR platform and opening the user to new ideas for what can be done with different creative applications.
- Tilt Brush it gives you a hole new perception and dimension of the world
- Tilt Brush still the fave
- Tilt Brush, because of it's immersive and spacial relationship usage aspects.
- Tilt Brush, Google Earth, and IKEA
- Tilt Brush, Medium, Google Earth, Robo Recall
- Tilt Brush Ease of use, self-expression, creating images in 3D in a way that's never been possible before.
- Tilt Brush, anyone can suddenly become an artist
- Tilt Brush, Labster, FingerFood All built specifically with 3D and VR in mind
- Tilt Brush. Meaningful human body and hand tracking that created best feeling of immersion
- Travel ones are best.
- Unable to say.
- Unity in terms of development and support - the adaptation of VR into retail spaces by Marxent (Lowe's Holoroom, etc) has been really impressive in terms of putting average consumers in the driver seat of process training and visualization.
- Unity: creation all the way.
- Unseen Diplomacy! Great locomotion user-interface
- Up until now the TheBlu was my favorite experience as it introduced greatest level of presence to me. Best graphics versus performance levels, very inspiring to see the potential of level of immersion that can be achieved when things get balanced out carefully.
- Valve's bow and arrow mini-game is the best in class of everything I've seen.

APPENDIX: Literal Answers (Best VR/AR/MR Uses, cont'd.)

- Virtual Rick-ality for the humor.
- Virtual Rick-ality is great experience in HTC VIVE
- VR Accounting by Squanchtendo. Respecting player agency
- VR film - Allumette; adds dimension and empathy to storytelling.
- VR: Unseen Diplomacy - A steam game for HTC Vive that is truly immersive, and is by far the best example of locomotion in VR. AR: Nothing, I guess, if you use the term "augmented reality" very very loosly, Pokemon Go.
- VRChat. Social VR is the best use of VR, and will slowly drive more market share
- Werewolf (social gaming), Tilt Brush (instantly understandable kinetic vocabulary), Brookhaven Experiment (stressing 360 and spatial audio), theBlu (Whale - presence/scale)
- Windlands, it is a very beautiful game and an engaging experience. I also like Within; wonderful story.
- Within VR is definitely one of them. And John VR..
- Woorld, Climb
- Zero Days VR, Carne y Arena, Life of Us, Alumette, Virtual Virtual Reality, Robo Recall. They were truly designed, thought of and made to be viewed as an immersive experience or game.