VIRTUAL REALITY: A VIRTUAL GOLDMINE FOR INVESTORS

Immersive Gaming and Content Platforms are Finally Here

November 8, 2014

Virtual Reality (VR) is about to become mainstream and could be a $7 billion market by 2018. Numerous head-mounted displays are in development (but not commercially available) with Facebook’s Oculus, Samsung, and Sony leading the pack, and Nintendo not far behind. If Samsung’s Gear VR remains wireless, it could dominate the mobile gaming space since 78% of the world’s 1.2 billion gamers are mobile. Oculus could evolve into Facebook’s next generation social networking platform in addition to providing interactive immersive play for Facebook’s 1.3 billion subscribers.

Augmented Reality (AR) is already here, with numerous companies servicing the retailing and engineering sectors not to mention Google, which led a $542 million funding round for Magic Leap, an AR startup whose product hasn’t even been announced.

We detail some of the more interesting technologies in this report and highlight several companies participating in the market including Sophic Capital client Spectra7 Microsystems (SEV-TSXV).

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Introduction

For decades, aviation simulation companies and the military have used virtual reality (VR) for training. This included VR “rooms” with floor to ceiling display panels that created “virtual worlds” (although the latency of the motion to image change time was prohibitive.) Although many articles have appeared concerning VR’s potential usage in the medical, educational, and military sectors, we believe that VR’s initial potential lies in the gaming and social media industries.

With the emergence of major VR gaming hardware innovators such as Samsung, Sony, and Oculus (purchased by Facebook in 2014 for $2 billion), we believe that VR gaming is real. Investors have the opportunity to invest in the early stages of a disruptive gaming technology that people have talked about for decades. VR gaming is here and could make its way to retailers’ shelves as early as December of this year, with 2015 expected to be the real breakout year where several platforms are anticipated to be released.

Using consulting firm KZero’s forecasts, the VR market could reach $7 billion by 2018, with room to grow. In arriving at this forecast, KZero estimates VR hardware revenues to be worth $2.3 billion by 2018. The firm also predicts about $4.7 billion of VR software (games and apps) revenues by the same time. Summing the two KZero forecasts, we arrive at the $7 billion estimate. We remind investors that VR gaming is in its infancy; as of 2013, there were 1.2 billion gamers in the world and none of them had head-mounted displays (HMDs), input systems, and software needed to play VR games.

Yes, people love their mobile games. They’re fanatical (maybe even addicted), with 10% of 602 gamers surveyed saying that they have played a mobile game while driving a car, at a movie theater, and even at a place of worship. VR is the next big thing for all gaming, and devices like Samsung’s Gear VR will immerse mobile gamers in new worlds for their next great adventure - but not while they’re driving, we hope.

Haven’t We Talked about VR Forever?

Not “forever” but close to it. VR is the immersion of an individual into a computer-generated world. Science fiction has been littered with VR references, ranging from the robots in the Matrix who plugged humans into a computer to keep them mentally stimulated, to Captain Kirk’s holodecks. But real VR systems preceded the gaming industry’s interest. In 1962, Morton Heilig was granted a patent for his Sensorama Simulator, a machine that played 3D film, stereo audio, implemented wind generators, and exhaled an array of aromas for what many consider history’s first VR experience. From there, the U.S. military experimented with VR, trying to incorporate a display into pilot helmets.
Then came the birth of modern HMDs. In 1968, Ivan Sutherland created a 3D stereoscopic HMD, which he called the “Sword of Damocles”1, to improve flight trainers (Exhibit 1). It was this idea of using a visual display to merge the human and artificial worlds which led to the HMDs in development today for the next stage of the gaming industry.

Exhibit 1: Ivan Sunderland’s 3D Display, Named “Sword of Damocles”

Gaming Trends – Give us More VR Please

VR is a gaming trend that is only going to get bigger. E3 2013 was abuzz with a VR prototype game developed by CCP called EVE Valkyrie that won several awards at the show. The game utilized a VR headset from Oculus, which debuted at CES 2013 and attracted a lot of attention and sales - Oculus quickly sold 60,000 of its Oculus Rift DK1, and 20,00 of the 60,000 second generation development kits (DK2) have shipped”. Facebook noticed and bought Oculus for $2 billion on March 25, 2014, potentially giving the VR platform a 1.3 billion person audience.

Fast forward to September 2014, to when Oculus held its first developers’ conference, Oculus Connect, attended by 800 developers. CTO John Carmack presented a speech outlining Rift’s technological challenges and where the technology is heading. But in spite of the gamer hype and the developer enthusiasm, commercial Oculus headsets still aren’t available. However, at Dublin’s Web Summit in November 2014, CEO Brendan Iribe stated, “We are still working on a number of aspects, but the hardware is almost there for the consumer product. The headset is largely finalized at this point.”vi Although he would not commit to a release date, Mr. Iribe further said that the consumer version is “months, not years away, but many months.”vii VR may no longer be a “virtual” reality – it’s closer than we think.

During Facebook’s third quarter 2014 conference call on October, 28, 2014, CEO Mark Zuckerberg reiterated that Oculus was a long-term bet on the future of computing. He noted that it will “take a bunch of years to get there” and that he didn’t think it would “get to 50 million or 100 million units in the next few years.” This suggests to us that Facebook could not only see VR as the future of gaming and social networking, but as an actual computing platform, perhaps

1 The unit was suspended from the ceiling from a metal rod, much like how King Dionysius had suspended a sword by a horsehair above one of his court’s flatterers, Damocles, so that the latter could experience what it felt like to be a King.
with VR as an interface. Why scroll a mouse when your eyes could tell your computer where to navigate? Why type when subtle head movements could point to letters or words?

**Sony Computer Entertainment has jumped on the VR bandwagon with “Project Morpheus.”** Designed to integrate with Sony’s PS4 gaming system, the company views Morpheus as an opportunity to push the boundaries of play. However, Shuhei Yoshida, the President of Sony’s Worldwide Studios, recently said that beyond gaming there are other applications. He described VR as “the feeling, the belief that all your senses believe that you are in a different place.” He then shared the ideas of traveling to Barcelona virtually or being on the moon.

For now, Morpheus will not compete directly against Oculus since Oculus is focused on the PC gaming market and Morpheus is meant for the PS4. Mr. Yoshida has conceded that Sony has finished 85% of Morpheus’ development. And although he would not divulge a release date or pricing, Mr. Yoshida stated that Morpheus won’t be available in 2014. He further offered that when Sony does release Morpheus, the public should not expect a $1,000 price point.

**Samsung won’t be left behind.** On September 3, 2014, during Samsung’s Unpacked 2014 event, the company unveiled its Gear VR platform. Developed in conjunction with Oculus, the Gear VR headset is a shell that slips over a Samsung Galaxy Note 4 for its video screen. It’s quite clever since one connects Gear VR to a wireless device rather than a PC or gaming console.

Speculation exists that Samsung’s Gear VR will be the first to market, possibly as soon as December 1, 2014 in South Korea and at a cost of about $187 (Galaxy Note 4 not included, but currently priced at $825.99 at AT&T or $299.99 with a 2-year contract). Given the need to have a Galaxy Note 4 for Gear VR to work and assuming that the Note 4 is bought on contract, the true cost is similar to the $350 Oculus’ Rift development kit. We believe Samsung could also announce a VR product similar to Oculus that could be plugged into its large TV install base.

Even if the speculative pricing for Samsung’s Gear VR is true, Oculus still looks like the leader in the market. Oculus is at the forefront of modern HMD and VR development. When Facebook announced its $2 billion purchase of the company, CEO Mark Zuckerberg posted that gaming will be the first experience for customers, and Facebook hopes to accelerate Oculus’ plans. Zuckerberg also detailed future plans for Oculus; plans where Oculus’ VR technology could allow users to “share unbounded spaces and experiences with the people in your life.” To us, this hints that Oculus VR could power a new social networking platform for Facebook. To scientists at Carnegie Mellon University, this means landing a robot on the moon that will allow Earthlings to view the moon’s surface with Oculus Rift HMDs.

**Google is also targeting VR, not with Glass but with Cardboard.** At this time, Google Glass is more of a hands-free information system that can do things like measure your golf swing, navigate the Earth, and record and send video messages. Cardboard, on the other hand, is literally a cardboard box designed to pair with a mobile phone (similar to Samsung’s Gear VR platform). Cardboard uses the phone to track head movement thereby allowing users to interact with the environment.
Amazon.com retailers sell Google’s Cardboard at prices starting at $2.39. What you’ll receive is a cardboard box embedded with lenses and a near-field communication chip to launch an app that users must download. Google also provides Cardboard plans for users to make their own, the same plan many of the Amazon retailers use for their kits. Some may view Cardboard as gimmicky, but we will have to see how successful this product is. Who knows? If nothing else, it could bring VR to the masses and spur VR app development.

**Consumer VR Market Could be Worth $7 Billion by 2018**

In 2013, research firm Gartner\(^\text{xiv}\) estimated that the 2013 global gaming market could reach $93 billion (from $79 billion in 2012) and grow to $111 billion by 2015. IDATE\(^\text{xv}\) predicts that the current global video game market will grow from about €54 billion in 2013 to €82 billion in 2017. DFC\(^\text{xvi}\) forecasts that gaming software alone could grow from $64 billion in 2014 to $100 billion by 2018.

**Our question is: How big could VR gaming become?** Summing KZero’s predictions of $2.3 billion\(^\text{xvii}\) in VR hardware sales in 2018 and about $4.7 billion\(^\text{xviii}\) in VR gaming software and apps by the same timeframe, we arrive at the $7 billion estimate for the entire market. Although the market value is small, we remind investors that commercial VR gaming is still in its infancy, targeting only 39 million gamers in 2018. This equates to only 3% of the estimated\(^\text{xix}\) 1.2 billion gamers in 2013.

MarketsandMarkets\(^\text{xx}\) forecasts the global HMD market to reach approximately $12.3 billion by 2020. We note that this forecast considers non-immersive (systems using a workstation) HMD as well. Consulting firm KZero anticipates HMD sales to grow from 200,000 units to 39 million by 2018 (Exhibit 2).

KZero\(^\text{xxi}\) projects VR input systems growing from about 2,000 units in 2014 to about 10 million in 2018 (Exhibit 3). Input systems are accessories such as suits and gloves that interact with VR systems, and the growth of this market sector should straddle HMD purchases. We anticipate that many input systems will cost more than HMDs because gamers will wear them, thus necessitating different manufacturing processes (fabrics and electronics) which command a new set of design challenges beyond steam-injected plastic modules for console platforms. KZero\(^\text{xxi}\) also forecasts the VR software market to grow to almost $4.7 billion market by 2018 (Exhibit 4) from about $1 million in 2014.
Exhibit 2: HMD Unit Sales to Grow from 200 Thousand to about 39 Million over 5 Years


Exhibit 3: Input Systems to Grow from 2 Thousand to over 10 Million over 5 Years


Exhibit 4: Software Revenues Scales to $4.7 Billion as VR Moves Beyond the Innovators

Samsung Targets a $24 Billion Global Mobile Market by 2016

Of the 1.2 billion gamers worldwide in 2013, 966 million (78%) of them played mobile games. But as Exhibit 5 illustrates, less than half of them pay, and their monthly average ARPU in 2013 was $2.78 (expected to grow to $3.07 by 2016.) Overall, the global mobile games market could reach $24 billion by 2016.

Samsung’s Gear VR platform looks well positioned to capture a large share of the mobile gaming market. The company designed its Gear VR HMD to utilize a Galaxy Note 4 as the screen. By using a mobile device that can access content from almost anywhere at any time, Samsung has an excellent opportunity to have a lead in capturing a large share of the 966 million mobile gamer market. We believe Samsung will also have to come out with a wired device to address the market at home where users will want to connect to their TV’s for immersive content.

Exhibit 5: Mobile Gaming ARPU’s by Platform and Region


* per month per paying mobile gamer.
**VR is more than Gaming**

Filmmakers are already starting to think differently about how VR can immerse movie goers into the plot. Fans could interact with characters, play with the stereo in a $400,000 Lamborghini, or trample across planet Zoltan’s sulfur plains. To achieve this, filmmakers have to think from moving from behind the frame to inside of the frame. Will they do it? We think so, since the filmed entertainment industry is projected to be generate $100 billion by 2017 (Exhibit 6).

But don’t take our word on it. On October, 28, 2014, Zero Point, a 3D, 360-degree documentary directed by 2011 Academy Award nominee Danfung Dennis, was released for the Oculus Rift developers. And to promote director Christopher Nolan’s next film *Interstellar*, Paramount Pictures, IMAX, and Oculus Rift collaborated to create a VR demonstration that allows fans to explore the spaceship used in the film.

The healthcare industry is set to adopt VR to lower practitioner training and patient costs. The entire medical simulation market could be worth $1.9 billion by 2017. This estimate includes haptics, where VR provides feedback through the sense of touch. Again, we urge investors to consider that at this time, VR for commercial applications is at the tipping point for adoption.

Military VR simulation, modeling, and virtual training is estimated to be worth $8.1 billion in 2014. Sandler Research calls for a 1.9% CAGR from 2014 through 2018 in the global military simulation and virtual training markets.

**Exhibit 6: Film Entertainment Revenue Forecasts ($Billions)**

![Exhibit 6: Film Entertainment Revenue Forecasts ($Billions)](chart)

*Source: PwC, Global entertainment and media outlook 2014-2018, June 2014*
Augmented Reality is Already Here and Moving into Gaming

Augmented Reality (AR) is where the real and digital worlds collide. It’s where digital characters, images, and objects are layered on top of our real-world surroundings. Ideally, the human mind should not be able to differentiate between what is real and what a computer has generated.

AR application developers could invest $2.5 billion by 2018. This is from an estimated 2013 base of $670 million.

AR already has a foothold in business marketing. Companies such as Tesco, Argos, and Kellogg’s have embraced AR marketing. For example, Tesco has an app that allows customers to preview a product via an AR app. The app uses the customer’s smartphone or computer camera to record the customer and then superimposes the product into her world via the device’s screen. The customer can spin the product to look at it from all angles before making a purchase decision.

The Race Yourself app gives Google Glass a basic AR experience. Race Yourself (see picture below) allows Google Glass wearers to race in computer generated marathons or get chased by zombies on their jogging routes. Although the characters are clearly computer generated, this is a significant step to bring computer-generated characters into the real world. But this is not Google’s only venture into AR because...

...Google recently led a $542 million funding round for AR startup Magic Leap. Little is known about Magic Leap, but in a February 2014 press release about the company raising $50 million, CEO Rony Abovitz stated that, “Magic Leap’s mission is to develop and commercialize what we believe will be the most natural and human-friendly wearable computing interface in the world.” Google obviously believes in the mission; so do Qualcomm, Andreessen Horowitz, KKR, and Legendary Entertainment – all investors in the recent funding round.

Source: Race Yourself

Source: Todd Wasserman, Mashable.com
Developers are Creating Content to Support VR Platforms

Developers are already working on games, movies and applications to support VR. While lack of content has been a common complaint when gaming consoles are released, generally content quickly catches up. For VR, the Oculus development kits are out there and developers are flocking to development conferences. The desire to create content is there, and almost every day we hear about new games, movies, and experiences that developers are working on. These include the VR games released and under development shown in Exhibit 7.

Exhibit 7: Virtual Reality Games Released and Under Development
So What’s Inside Oculus Rift?

iFixit, an online community of people who like to know how things works, tore apart an Oculus Rift HMD to discover what made it work. What they found were chips from the following companies:

Spectra7 Microsystems (TSXV:SEV), a Sophic Capital client, provides a key component that powers Oculus headsets. The component is Spectra7’s VR7100 processor, “which reduces the size and weight of HDMI interconnects while supporting 4K 60FPS video” according to the product brief. iFixit's teardown folks were far more explicit: “Hot stuff!” they commented. This unique hardware company also offers weavable interconnects that can thread through wearable input systems and deliver real-time 4K-Ultra HD resolution. In October 2014, the company announced a high-speed, low-latency chip for recognizing gestures and motion control in VR HMDs.

InvenSense (NYSE:INVN) provides the Oculus’ motion tracking with its MPU-6500 chip. This device integrates a 3-axis accelerometer and a 3-axis gyroscope and claims to have a 45% smaller package than competitors - all while consuming almost 60% less power. Motion tracking is InvenSense’s niche, and the company supplies the smartphone, tablet, wearables, and gaming markets.

Toshiba (TYO:6502) has its TC358779XBG chip to bridge HDMI signals to DSI. In English, this means it converts digital data so that the data can be displayed on the HMD’s screen. Toshiba made a name for itself with its famed Toshiba Head Dome Projector, a diving-helmet sized apparatus that swallowed the user’s head. After a string of not-so-kind articles regarding its bulk, the Head Dome Projector was never seen again.

STMicroelectronics’ (NYSE:STM) STM32L100RB appears to control all activity on the Oculus’ motherboard. This microcontroller has applications beyond gaming including: medical equipment, handheld equipment, alarm systems, and utility metering. STMicroelectronics also has a range of accelerometer and gyroscope chips which could be used in VR hardware.

Samsung Electronics (KRX:005930) illuminates the Oculus Rift. iFixit uncovered that the Oculus Rift’s display is a Galaxy screen, complete with Samsung’s logo.
**Notable VR and AR Companies**

ARCHOS (EPA:JXR) is a French manufacturer of entertainment products that’s entered VR in a big (or small if you look at cost) way. The company plans to release a VR HMD in November 2014 that follows Samsung’s lead by using a smartphone (any smartphone) as the screen. Now here’s the kicker: The HMD’s prices start at $29.99xxx.

**ARToolworks is a Seattle-based AR tool developer for standalone and mobile applications.** The company claims over a million downloads of its ARToolKit software (and ARToolKit’s derived products.)

**Augmented Pixels has created games but is focused on commercial AR applications.** The company offers a diverse set of AR solutions that allow: real estate developers to present new buildings to potential customers, users to experiment with furniture placements by creating virtual showrooms, and AR game development to engage customers with products.

**Aurasma’s AR platform allows customers to create and publish their own AR content.** Aurasma claims over 70,000 customers including: Lexus, Kellogg’s, Honda, and Argos (which built over 300 AR pieces into its catalogue.)

**Blippar is another company focused on AR marketing.** The company has an app that utilizes a smart device’s camera to recognize a physical object causing the app to trigger things such as a video, bringing the user to a website, or dialing a phone number for more information about the product.

**Eon Reality provides VR knowledge transfer solutions for businesses and educational institutions.** Types of knowledge transferred could be marketing presentations or safety instructions. Eon Reality also has educational/entertainment (what it calls “edutainment”) VR content that allows people to experience things such as swimming with a great white shark or aid in preparing football players for the big game.

**Innovega is a contact-lens-based HMD manufacturer for the VR and AR markets.** How does it work? Cameras mounted on a pair of glasses project images onto a pair of spectacles which the user views through contact lenses. By projecting the images close to the eye, it becomes easier to make a high resolution, wide-field display in a compact form factor.

**Kishino also targets the retailer AR marketing space.** It powers the Tesco solution that we highlighted in the previous section. It also counts Walmart, HMV, and Tommy Hilfiger as clients.

**Qualcomm (NASDAQ:QCOM) has its Vuforia mobile vision platform for AR.** More than 100,000 developers support it and have created upwards of 10,000 commercial apps. Qualcomm will soon release a Vuforia software development kit for digital eyewear which will allow developers to create apps for VR and AR platforms including: Samsung’s Gear VR, Epson’s Moverio BT-200 (Epson’s smart glass offering), and Google Glass.
Seebright AR/VR platform provides users with a wireless HMD and controller. Users install a smartphone over the HMD, and the headset projects content to the eyes via a mirror. The solution is like a hat, seated above the eyes which allows for natural undisturbed field of view.

Sulon Technologies is another VR platform entrant. It’s competing against the biggest names including: Oculus, Sony, and Samsung. However, the platform’s secret sauce is the ability to turn any room into a VR space. We find this appealing because consumers already demand personalization for most of their electronic content (video, music, gaming avatars). Why not rescue people that bank robbers are holding hostage in your home’s attic?

Thalmic Labs offers a VR armband called Myo that can connect to any Windows, Mac, iOS, or Android devices with a Bluetooth Smart connection. Myo has gaming applications that could eliminate controllers, thereby freeing a gamer’s hands. But the device also could gain traction in the enterprise: Think a mechanic with greasy hands who has to navigate through webpages to access information. Myo could allow his hand motions to flip through the pages without dirtying the computer’s keyboard or mouse.

VRVANA (rhymes with Nirvana) is a Montreal startup that has developed a HMD called Totem. Totem comes with two onboard cameras and offers 360-degree positional tracking. It also has an onboard hardware accelerator which helps to offsets optical distortion (every millisecond counts in VR.) Totem is backward compatible with any 3D, side-by-side, HDMI source. VRVANA offers pre-order development kits for $450.
**Virtalis** has VR systems and solutions across a broad range of industries that allow employees to interact with enterprise data. This helps products to foster communication amongst employees which Virtalis believes can generate return on VR investments.

**Virtuix Omni** provides a treadmill VR input system that allows gamers to move freely and naturally. With the treadmill, gamers can run, walk, crouch, and twist to experience a more lifelike gaming experience. The company claims that the fitness industry has taken an interest in the technology since all that movement burns calories.

**Vuzix Corporation** (TSXV:VZK) is a supplier of smart, VR, and AR eyewear. The company has a one-year partnership with Lenovo to supply Vuzix’s M-100 smart glasses into the Chinese market.

**Risks to the VR/AR Industry**

**First generation consumer hardware disappoints.** We don’t know which platforms will be first to market, but whoever it is had better make sure their platforms work well or else a wave of negative press, blogs, and social networking condemnation will ensue. Oculus and Samsung demonstrations have excited gamers; even Google’s Cardboard has people chatting about the wonderful benefits of VR for the masses. Hopefully, the high-end VR hardware manufacturers can deliver en masse.

**Industrial design needs to improve.** While many gamers and early adopters have given the Oculus experience two thumbs up, someone pointed out to us that the Oculus “looks like you’re wearing a brick on your face.” Much like how the first mobile phone also looked like a brick (think of Michael Douglas in Wall Street), the industrial design as well as the functionality of smartphones today have evolved into features that convey social status. While the first commercial products should deliver a stellar experience, it may take a few more years before HMDs actually look cooler.

**Will VR go the way of 3DTV?** Several years ago, the next big thing was supposed to be 3DTV. The problems with 3DTV were that people just didn’t want to wear the glasses and the content didn’t come fast enough to support wide adoption. While many people seem to go to 3D movies in the theatre, the trend to move 3D into the home never really took off. Given the large gaming community and the potential for them to experience VR together, we don’t expect a similar outcome, but we still need to highlight it as many analysts and technology reporters had expected 3DTV to be a huge success as well.
Conclusions

Virtual reality is about to become a gaming reality. The hardware is almost ready, developer interest is high, and gamers want VR. All the pieces are in place for what could be a $7 billion industry by 2018.

Augmented reality is a reality. Although not prevalent in the gaming world, AR seems to have found its niche in the retailing and engineering industries. Plus, Google has led a $542 million funding round for Magic Leap, an AR startup whose product hasn’t even been announced. Consumers are engaging, workers are collaborating, and app developers continued to release new titles.

We believe that investors will do well focusing on investments that will benefit from the growth of VR and AR over the coming decade. One such investment is Spectra7 Microsystems (SEV-TSXV), a Sophic Capital client. Spectra7’s VR-leading interconnects are positioned to do well given their early adoption in Oculus according to iFixit. Plus, we believe the company’s technology has applications into other markets beyond VR, AR, and wearables.

Acronyms Used in this Report

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<td>4K</td>
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<td>AR</td>
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<td>average revenue per unit</td>
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Virtual Reality: A Virtual Goldmine for Investors

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