AUGMENTED REALITY: GLASSES GETTING CLOSER TO REALITY

Awed by the AWE 2015 Conference

June 16, 2015

We briefly discussed the potential of augmented reality in our three virtual reality research reports. We knew that augmented reality is a more mature and larger market opportunity than virtual reality. However, it wasn’t until we attended AWE 2015, one of the industry’s most important conferences, that we realized how far the technology in the glasses (or heads-up displays) has advanced. Although it is still likely years away for smart glasses to be commonplace, we are convinced that augmented reality will change the world in the same scales as radio waves, the transistor, and the internet. In the report we look at the state of the market and highlight some of the key players to watch as the market develops.
Introduction

Last week, we attended the sixth Augmented World Expo (AWE) in Santa Clara and were wowed by what we saw. AWE featured over 200 companies across the augmented and virtual reality sectors as well as wearable technology. Not only did the hardware and software solutions impress us, but we had to completely reconsider how we view augmented reality (AR). Along the way, we spoke to numerous industry executes, experts, and enthusiasts – the people who live and breathe this stuff.

At AWE 2015, we uncovered the following AR themes:

1. Enterprises are adopting AR en masse, especially some of the largest,
2. For now, many enterprises are resisting AR glasses and opting for tablet solutions,
3. Consumer adoption of AR is likely a ways off;
4. The potential for AR is massive – there is too much under-utilized data, and enterprises don’t know how to leverage it,
5. AR shouldn’t replace existing enterprise processes; it should complement processes and improve efficiencies,
6. AR and virtual reality (VR) are converging, and
7. Although gaming dominates VR, it doesn’t have as large a presence in AR.

What’s this Augmented Reality Stuff?

AR is the generation of computer-generated images and data onto the real world. VR, on the other hand, is the immersion of ourselves into a computer generated world. While some people may believe AR requires smart glasses or a heads-up display, it is important to recognize that there are several examples of AR today that do not.

For example, the National Football League’s first down line marker and the down and yards-to-go indicators are examples of AR. Others include companies like OPS Solutions (private) that use light projectors in manufacturing plants that guide employees in their work and are proven to improve efficiencies and reduce errors.

We believe AR will be initially focused on live training, teleconferencing, design, ecommerce, and marketing, whereas VR will initially be driven by gaming and watching content. When thinking about the eyewear, another difference is that AR requires clear lenses to integrate...
computer-generated images into our world whereas VR uses dark lenses to immerse the user into the computer generated world. As such, AR is mobile whereas VR is usually immobile (we wouldn’t want people to be crossing streets if their view of the outside world is blocked in VR). We believe that eventually VR and AR will converge so users can seamlessly transition from AR to VR and VR back to AR.

AR glasses could replace smartphones and tablets one day. This is what a panel of experts stated at the NeuroGaming Conference in May. Given that Americans now spend more time interacting with their mobile devices than their televisions, it isn’t difficult to fathom that integrating the majority of the functionality of the mobile device directly into your periphery is the next step. As frightening as this may seem to some people. While today AR glasses remain somewhat bulky with their cameras, microphones, speakers and cables, we believe form factors will continue to evolve and eventually become stylish fashion accessories.

Market Forecasters are All Projecting Huge Numbers

AR apps are forecasted to ramp – BIG! Market intelligence firm Tractica forecasts 272 million AR apps downloaded in 2014 growing to 1.2 billion by 2019, accounting for $1.6 billion in mobile AR app revenue. Within the enterprise, Juniper Research is bullish; the firm projects AR app revenues will grow from $247 million in 2014 to $2.4 billion by 2019. Juniper also forecasts that mobile AR app revenues will hit $1.2 billion in 2015, up from $180 million in 2013.

Shipments of smart AR glasses will accelerate. Tractica estimates that 114,000 units will ship globally in 2015 and 5.4 million units by 2020 (Exhibit 1). In total, 12.2 million units will ship over the forecast period.

Smart glasses revenues will surpass smart watch revenues by 2020. According to research firm TECHnalysis Research, glasses and head-worn wearables could hit $13.5 billion by 2020. This represents 43% of the total wearable forecast.
Sophic Capital’s Analysis of the Market Opportunity

Based upon what we saw and heard at AWE 2015, we believe that augmented reality could be a very large market, but is still years away from being consumer-ready. We believe glasses will eventually replace smartphones and tablets. In 2003, 14.6 million smartphones were sold globally\(^v\). Exhibit 2 illustrates eMarketer’s smartphone forecast, calling for over 2.5 billion phones by 2018. This represents almost 52% of all mobile devices sold. Ericsson (NASDAQ:ERIC) forecasts that by 2020 there will be 6.1 billion smartphones compared to 2.6 billion in 2014 and 1.8 billion in 2014\(^viii\).

Exhibit 3 shows total mobile broadband (smartphones, dumbphones with broadband access, mobile computing devices) subscribers going back to 2007. Exhibit 2 shows that smartphones had 34% penetration of all mobile devices in 2013. Projecting a 30% ratio onto Exhibit 3 suggests that there were about 80 million smartphones back in 2007, which ramped from 14.6 million in 2003\(^ix\). We believe that glasses could follow a similar ramp.

In fact, independent research hints that glasses adoption is in the early stages. CCS Insight forecasts that by 2018, glasses will compose 2% of the 185 million wearables\(^x\). This translates into less than 4 million glasses products by 2018. Glancing at the 2020 Analysis Mason’s forecast (Exhibit 4), we estimate that the number of glasses could reach 15 million.

What does this prove? First it illustrates that the market for AR glasses is still in its infancy, which makes forecasting a challenge. Second, stringing the data points together suggests that a smartphone-like ramp could occur over the next few years. Lastly, it appears as though everyone is coming to the same net conclusion: The AR hardware market has huge potential. Remember,
Exhibit 2: eMarketer Smartphone Forecast

![Smartphone Users and Penetration Worldwide, 2013-2018](image)

Note: individuals of any age who own at least one smartphone and use the smartphone(s) at least once per month
Source: eMarketer, Dec 2014

Source: eMarketer

Exhibit 3: Historical Adoption of Mobile Broadband Subscriptions

![Historical Adoption of Mobile Broadband Subscriptions](image)

* = Estimate

Source: ITU, Sophic Capital
these numbers represent only the hardware and don’t include software sales of AR. And we believe the AR software market has virtually “augmentally” limitless potential given the infinite end uses that AR holds.

**AWE Presented how Awesome AR Is**

**AR is in its infancy, and it is not going away.** Industry titans such as Boeing, Johnson & Johnson, and Bosch have embraced the technology. We saw a number of education, military, and health applications. We even saw an app from Oxford University that helps legally blind people to recognize shapes and facial expressions. Several industry experts mentioned during their presentations that AR will be prevalent in the enterprise within five years. This is not an unrealistic forecast when you consider that less than three years ago, few tablets were on manufacturing floors. Going further back, mass adoption of smartphones didn’t start until the early 2000s (some would argue 1999, to be exact).

**Interacting with a mouse or keyboard is unnatural to the human body.** We were meant to move within our environment and not sit around pounding our fingers or tapping with our index finger. Even using our heads to point is unnatural. We are creatures that interact with space, and this conflicts with staring into a computer or smartphone. AR is a 360° display allowing us to interact with the space around us and track digital information that AR computers generate within our environment.
Enterprises want to use AR to convert under-utilized data to information. Every day, enterprises create 2.5 quintillion\(^1\) bytes of data\(^{11}\) (90% of the data in existence was created within the last two years\(^{12}\)). Most of that data is idle and could be leveraged to drive efficiencies in enterprises. More important from the enterprise perspective is whether or not AR generates ROI. Driving a single, small inefficiency out of a Fortune 500 company can generate huge cost savings.

The majority of what we saw at AWE 2015 was geared towards the enterprise. Qualcomm (NASDAQ:QCOM), in partnership with Mini of BMW Group, demonstrated a glasses-based AR application that gave directions in a driving simulation. VA-ST (private) had a solution to enhance sight in the legally blind. But other than these, we didn’t see much for the consumer market. One reason why – and we believe it is an important reason – is because the form factor of the glasses are not yet stylish and consumer-ready. In fact, we spoke with an Oakley (private) representative who indicated that AR glasses have a long way to go to be palatable to consumers.

SAP (NYSE:SAP) and Oracle (NYSE:ORCL) are the de facto standards for AR software integration. This makes sense since these two companies target the enterprise, which is the market embracing AR. Given this, developers have had to use these solutions to interface with glasses. Unity (private), provider of game development tools, is getting noticed for its interface for smart glasses. Although it remains a dominant player in the gaming space, the Company appears to be branching out.

**Smart Glasses are Getting better but are Still Years Away from Mass Adoption**

One note of short term caution – most glasses, although impressive, are not quite ready for large enterprises. A consultant, who wished to remain anonymous, at a major industrial firm that caters to Fortune 500 companies told us that the headsets are not ready for his customers. His clients embrace AR and have implemented solutions with tablets. In many cases, tablets were the best solutions for the end user, but in other cases, clients disliked the ecosystem of glasses form factors and their current tiny field of view. An aerospace executive hinted that his biggest problems with smart glasses is they don’t work. This

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\(^1\) A “quintillion” is a one followed by 18 zeros.
doesn’t mean that these Fortune 500 companies will never switch to glasses. Neither does it mean that enterprises aren’t implementing glasses-based AR solutions (APX is a private company that is having great success using glasses to host its AR solutions). There is no “one size fits all” solution in AR.

There were few gaming apps. IMMY (private) demonstrated a cool pinball game for its dual AR/VR glasses (the Company is primarily targeting the AR market). We also saw a virtual fortune teller, and caST AR (private) is known for its fun content. At the Epson booth we played a Ghostbuster game, but have to say it was underwhelming. Until AR games can fully interact with our physical space (think of shooting Aliens that break through a physical wall, or playing a game that opens up from your kitchen table), we believe people will opt for current gaming mediums like PCs, consoles, mobile devices and VR. The enterprise wants AR now and from what we learned enterprise AR means minimalistic content – i.e. low graphic content. The idea is to enhance our world and not block it out with graphic intense video.

Field of View is Important and Remains a Challenge for Most

A constant theme at the conference was field of view (FoV). FoV, it seems, is one of the challenging issues in augmented reality glasses. FoV is the area that the user can see AR content while wearing the glasses. Larger horizontal FoV is important as most use cases would prefer to have information displayed on the periphery, while keeping the center of view clear to see the real world. Much like a smartphone today has information about battery, wireless connectivity and notifications pop-up on the edges so you can still see the screen, we believe AR glasses of the future will need to do the same. In order to do this the glasses will need a large FoV. Exhibit 5 demonstrates the diagonal FoVs of various glasses; IMMY (private) had an impressive FoV that the Company claimed was over 60°. Microsoft’s (NASDAQ: MSFT) HoloLens website doesn’t provide a FoV, but an industry expert at AWE believed it was about 30° but didn’t want to be quoted. Epson (TYO:6724) Moverio BT-200 is 23°, and Meta (private) has a 23° FoV with shade lens and 35° with expander lens.
AR Hardware Contenders

Given that hardware could be the largest segment in the AR market, we present some of the hardware vendors in this space. Our list is by no means complete; however, the companies we highlight have received significant press and are names investors should continue to see news flow from. Although it seems most players have some advantages and disadvantages, we have not seen a complete winning package from any player yet. The perfect package will be stylish, lightweight, have a large FoV and be able to run on for an entire day like today’s smartphones.

The Heavyweights

Holy HoloLens! Microsoft shook the industry when it unveiled Windows 10. The Company took the opportunity to introduce HoloLens, the world’s first holographic computing platform. Microsoft appears to see the value in workplace collaboration (lining up Disney, NASA, and Autodesk as partners); a demo showed one person drawing virtual diagrams to help a HoloLens wearer repair a light switch. But HoloLens is still in development.

Magic Leap (private), the company bequeathed with a $542 million investment last October (led by Google and including KPCB, Andreessen Horowitz, Obvious Ventures, Qualcomm and Legendary Entertainment), is at the forefront of much AR news. 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. " At the 2015 Game Developers Conference, the Company had a recruiting booth but remained tight lipped about any commercial or technical aspects of the product. But this month, CEO Ron Abovitz told MIT’s EmTech Digital conference that Magic Leap is “out of the R&D phase and in the transition to product introduction.” To support Magic Leap’s platform, the Company has also invited creators to develop content. The Company’s software development kit is expected to support the popular Unity and Unreal gaming engines.

**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. DHL also completed a pilot with Vuzix’s platform that resulted in a 25% efficiency increase. We were told that the next Smart Glass iteration will have integrated cameras, and the prototype looked like a regular pair of sunglasses.

**Japanese firm Epson (TYO:6724) has made its AR presence known with its Moverio family, and many fans saw it as a contender to Google Glass.** Wired to an Android-powered touchpad, Moverio sports two screens (one for each lens) whereas Glass was a single-display monocle. Moverio was first touted as a tool to help workers, but entertainment (including Netflix) and gaming applications entered its ecosystem. We tried the Moverio at AWE; they were comfortable and fairly easy to navigate, however the FoV remains fairly small at 35° (with expander lens).

**IMMY (private) is unique in that they have focused their technology around the optics in order to create an AR/VR headset that closely mimics the human eye.** Please read that again – AR/VR headset. Many companies claim to offer AR and VR in the same device, but IMMY appears to be the only company that has succeeded. Part of this success is due to the emphasis placed on the optics (10 years in development) accomplishing something that many optical experts say is impossible – creating distortion-less optics.

**Think about shining a flashlight on a wall.** The light is circular, but bend your wrist and the circle distorts into an oval. This is the problem with projecting an image onto a curved surface, yet IMMY has found a way to solve the problem to provide what could be the best projection/optical AR system in existence.
IMMY accomplishes this with the world’s first, and only, lens-less imaging optic, the Natural Eye Optic™ (N.E.O). The N.E.O. replicates the human vision system, providing the most natural and comfortable viewing experience possible. IMMY’s N.E.O. technology eliminates the limitations of existing optics technologies, thus delivering a large FoV, 3D AR/VR capability in a lightweight, wearable and mobile form-factor.

But what really impressed us was IMMY’s FoV. Humans interact most with horizontal FoV in order to have an immersive experience – we look side-to-side more than up and down. Everyone hears about Oculus’ 100° FoV, which is a diagonal measurement, and their horizontal FoV is approximately 55°. IMMY’s diagonal FoV is 60+°, but their horizontal FoV is around 54° - very close to Oculus’ horizontal FoV. This is why IMMY’s headset provides an immersive experience that rivals that of Oculus: The horizontal FoVs are similar.

Don’t take our word for it though; the San Francisco Chronicle showcased IMMY’s glasses in advance of AWE with the headline, “Has Oculus been trumped?” We also spoke with an Oxford University professor after he tried IMMY’s headset: His reaction was that “they were doing something fascinating and unique.”

Exhibit 6: Various Smart Glasses

Source: Augmented World Expo
Sulon Technologies (private) has its Sulon Cortex which changes how we interact with the augmented and virtual worlds. First, the Cortex is an AR/VR HMD. We were fortunate to have a demo prior to AWE and what we saw was possibly the coolest technology that we’ve ever seen. Our demo immersed us into a virtual world. However, unlike most platforms where you can move in a virtual world but not in the physical world, the Cortex tracked our movement. We walked, crouched, jogged through a room while battling dragons and never bumped into a wall. And at the end, we were teleported to a game “exit” where the augmented and virtual worlds merged. We stood in the virtual world and saw our hosts waving at us to step through the portal in the real world. We have never seen anything so fascinating before.

Sulon’s Cortex spatial mapping is not limited to gaming. We interacted with a virtual V8 engine that floated in the room. Using our hands, we exploded the parts, allowing us to closely examine the assembly. We stuck our faces into the cylinders, crouched underneath to look at the oil pan, and walked around admiring the rockers. It felt as though a real engine was hovering before us awaiting our inspection. Think of what this means from a design or manufacturing perspective. Design teams will one day modify parts on the fly, spot potential errors, or reconfigure assembly procedures because the Cortex knows where both they and their virtual worlds mesh together.

Meta raised $23 million in a Series A round and already has a development kit for its AR glasses (priced at $667). The Company’s AR glasses offer 960x540 pixel resolution, 360° tracking, and Dolby 3D audio. A colour, camera and infrared camera map your environment, and the glasses map the digital content onto transparent screens resting before your eyes. We tried Meta’s glasses and were impressed. Much like several other headsets, when we moved our head we noticed the bulky cable harness.

Google’s doing Something More Exciting than Glass in AR

Google Glass was one of the first AR headsets (many would argue it was a notification engine) to appear; unfortunately, it never seemed to catch on. Google released Glass as a work in progress to early adopters and journalists, rather than retail consumers, with the goal of letting enthusiasts provide feedback to improve the
wearablexxvi. The media fueled the hype, and the $1,500 glasses appeared in TIME, Vogue, and even The Simpsons (although Homer called them “Oggle Goggles”). But the novelty soon wore off, and many tech reviewers weren’t kind. Google Glass went away, but the company claims that there will be future versionsxxvii.

We believe Google’s Project Tango will be a BIG winner. Project Tango is a mobile device platform that brings devices a new level of awareness through area learning and real-time 3D motion and depth sensing that understands space and motion. It allows users to map any space, both interior and exterior. Then, Project Tango tracks your movement within that space across three dimensions.

The Google team demoed Project Tango for us. They started by collecting depth information, mapping the distances to tables, chairs, and a TV. Project Tango then drew the furniture, walls, and floor, filling in the colours along the way. As we walked around, Project Tango continuously mapped the area, filling in objects, colouring them as we moved about. We could measure distances and heights of objects from any point that Project Tango mapped. This is amazing stuff – kind of like Google Maps for the interior of buildings or something that we can use to create customized game environments.

Industrial Design Teams Will Focus on Style for the Masses

We believe the consumer market won’t ramp for several years. Enterprises are using AR now; however, current hardware, still has a several design iterations to undergo before becoming fashion forward. People have an aversion to looking silly, and bulky glasses with cameras and batteries will generate a lot of stares. Fashion comes first in the consumer market.

Most people know Oakley (private) for their consumer glasses. What some may not know is that a large part of Oakley’s business comes from providing military-specified, government, and safety glasses. A few glasses manufacturers mentioned that they are working to shrink their AR electronics into a pair of Oakley frames which leads us to believe that this is the aesthetic Holy Grail to drive consumer adoption. We had a chinwag with an Oakley representative who had finished an AR demo. We asked his opinion on what he had experienced at the show; he stated that AR had a long way to go in terms of form-factor: “The glasses are too bulky,” he said, yet he conceded that, “AR is in the early innings.”
We believe smart glasses will be tethered for the foreseeable future as on-board batteries, processing and storage limit capabilities, making the industrial design bulky. At the conference most of the smart glasses were tethered and many were tethered with multiple thick cables. Our view on cables sticking around for some time is based on our knowledge of one of our clients, who is reducing the diameter of ultra-fast cables by up to 80%. When cables get thin enough, we believe the benefits of being tethered outweigh a wireless solution.

Introducing Spectra 7 Microsystems (a Sophic Capital Client) (TSXV:SEV; OTCQX:SPVNF) who designs ultra-thin interconnects for the VR and AR market and could be just what industrial design teams have been looking for. To be clear, Spectra7 is not a smart glasses manufacturer but enables VR and AR hardware to be significantly thinner and lighter, while providing high speed video, data and audio required for the best user experience. The Company initially targeted the VR market with its VR7100 DisplayDirect™, which can condense four bulky cables (HDMI, USB, audio, and power) into a single, ultra-thin VR cable.

Why is this important? Many HMDs are tethered to a computer or other hardware, and four cables introduce significant weight and mobility issues. Although less is more in terms of cabling, Spectra7’s VR7100 does not sacrifice performance. In fact, the VR7100 provides more performance in a smaller package making it one of the most important components in VR hardware, in our opinion. But we’re not the only people who hold this opinion…

Spectra7 Microsystems’ VR7100 powers Oculus headsets. iFixit’s teardown of the Oculus Rift uncovered the chip (right photo) and caused them to comment that it was “Hot stuff!” Given that the VR7100 is part of Oculus Rift.

So how does this relate to the AR market? On June 5, 2015 Spectra7 announced the availability of AR-Connect™, the industry’s first and only integrated cable, connector and embedded chipset product line for AR vision systems and wearable computing devices. In the same press release the Company announced multiple design wins and over $1 million in orders in the second half of May alone. Based on what we saw at the conference, AR needs Spectra7’s technology much like VR has already adopted it.

AR-Connect™ enables augmented reality glasses to connect to a smartphone, proprietary processing device, or a desktop graphics/laptop processing unit with a single unified and ultra-thin link. Interconnect weight, diameter, speed, and low distortion are critical to AR
Designing AR Apps Requires a Whole New Approach

What can AR do? What do you need it to do? What is the problem that you’re trying to solve? AR is in its infancy. Enterprises are stuffed with data as Company servers are bulging with customer relationship management (CRM), enterprise resource planning (ERP), computer aided drawings (CAD), and manufacturing execution system (MES) data, to name a few. Data is usually siloed and protected by the departments and teams that created it. Worse, this data is underutilized by most of those teams. But in this big data world of ours, enterprises wonder what type of information resides in all that data and how to extract it? This is not a trivial problem.

**A good starting point about how to extract information from enterprise big data is to understand how humans think.** We are spatially-oriented creatures; you can probably recall the location of one thousand objects in your home. However, can you recall the last 15 numbers that you used? This illustration suggests that big data is best presented in a visual format, since this is something we understand and easily process. AR presents a medium that is perfect for achieving this.

**Another factor to consider is how we currently interact with data.** Typically, we reach for a mobile device, turn it on, start an app, scrutinize the data, interact, download, process, put the device away, and return to the task at hand. Although this disruption from our work routine usually takes less than 10 seconds, for a brief email for example, most of this time is wasted. That may sound insignificant, but summing ten seconds forty times a day per person across one thousand employees requires an investment of 110 hours a day to read brief emails – 110 hours of mostly wasted time. What enterprises seek is to minimize that waste. With smart glasses, the information is accessible with a tap or wave of a finger and presented before the worker’s eyes, keeping her focused on her work and significantly removing much of the wasted time. This is an example of how a small improvement in efficiency can save time and therefore reduce costs. Simple small movements save time and money.

**Smart glass app designers must consider safety and workflow with interaction.** Safety is always a priority in a manufacturing environment. Messaging a forklift driver via glasses while he’s driving could cause an accident. A better approach is a beep that would let him know that a message is waiting for him when he’s available. A machinist waving her hands before her glasses to access drawings as she turns metal on a lathe is another dangerous situation that needs safer user

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2 We believe this is half the amount of time that those same people spend plugging in USB Type A connectors.
interaction. Removing the machinist’s hand waves and even minimizing her eye movements as she scrutinizes plans could save her life.

**There may be more than one way to access an app.** Not all apps will be tailored to one end user. There could be multiple end users. One person may be in a wheelchair; another may use the app in frigid temperature; a third worker may use it in the dark. The app could be used across a broad ecosystem of devices as well. These considerations demonstrate that AR definitely is not a one-solution fits all mantra.

**After safety, we believe the most important design feature for smart glasses is social acceptability.** No one wants to look like a fool, yet some of the early generation smart glasses look plain silly. “Fashion first” is the mantra for all wearables, which is perhaps why watches have gained greater acceptance. But beyond the aesthetics, social interaction is another reason why enterprises have embraced (or will embrace) AR smart glasses yet consumers have not. It’s okay to wave your hands in front of your smart glasses on a factory floor, but repeat the gestures in your local pub and the lord may cut you off from the tap.

**So now that we know how to use enterprise data, what should the end use be for AR?** Some companies rush to implement AR solutions for the sake of having a solution. This is the wrong approach. Enterprises should ferret the inefficiencies in their operations and build a return on investment case for implementing AR, assuming AR is a suitable solution. They should look to reduce errors, which will save time and, in turn, money. The inefficiencies don’t have to be large to generate positive ROI; infrastructure companies, like airlines and construction companies, can realize large cost savings with small improvements to efficiencies.

**A Final Word about AR App Design in the Enterprise**

**The ideal solution should not replace a process but complement it.** This is because workers and customers are used to doing things a certain way, and the last thing enterprises want to do is completely disrupt process flow. Instead, enterprises should seek to improve process flow. No one knows the process better than the person who does it, which is why the discussions need to commence with the end user. She is the expert and knows how to drive out the inefficiencies to improve her workflow.

**Enterprise Markets**

**Only 31.5% of American workers were actively engaged in their jobs during 2014**[xiv]. This statistic begs the question, “Why?” Not every workers will cite lack of proper tools, training, and support, but we believe many will. And those workers represent the ones who may benefit from AR. AR can improve workflow efficiencies, build worker confidence via support and training tools, and perhaps eliminate that overbearing supervisor hovering over their shoulder.
Here are SOME of the use cases that could benefit from AR:

**Marketing**

There may not be enough zeros to quantify how large this opportunity could be. We’ve already seen Tesco (LON:TSCO), Argos, and Kellogg (NYSE:K) all experiment with AR marketing. One fascinating (in our opinion) AR marketing app was prototyped by Target (NYSE:TGT). Last December, Target partnered with Google’s Project Tango to create a mobile game experience at some of the stores. As children stroll through the aisles and play the games, in-store signage prompts them to discover special codes throughout the store to unlock characters and new game levels. When the game ends, the kids find themselves standing in the middle of the toy section (positioned to buy).

**Architecture**

The future sees architects collaborating in virtual and augmented worlds. Convergence of these two worlds was a theme that we heard several times during AWE 2015. Architects and engineers could teleport from different parts of the world and scrutinize CAD plans in their respective augmented reality spaces. Then, they could switch to a virtual world and immerse themselves into the actual building they were designing. They could see if a support beam interferes with a doorway, scrutinize the traffic flow of a hallway, or measure the height of an open workspace. This is a level of prototyping not available to architects before, one that could eliminate costly mistakes prior to breaking ground on a new project.

**Military**

Providing real-time information to soldiers could save lives. BAE Systems and the University of Birmingham are working on a portable command center that allows users to monitor situations, zoom in and out, manipulate environments, and direct troops. Another application involves a wearable cockpit that allows pilots to reconfigure their controls according to preference, mission, or situation.
**Design**

Augmented reality will not only speed up design and prototyping process but also create collaborative work environments. Imagine architects who are individually based in London, New York, and Tokyo. The architects could view the same building design and modifications in real-time without being in the same room. Similarly, interior designers could rearrange furniture, change wall colours, or hang different pieces of art to consolidate the room. Auto engineers could see how engine pieces mesh together, tweak transmission gearing to optimize performance, or adjust a car’s curves to improve aerodynamics. A team of toy designers could also play with a doll’s features and print several prototypes on a 3D printer. The possibilities for AR in the design industries is limitless.

**Health**

We believe AR will revolutionize medical diagnostics and doctor training. Everyone has heard about flight simulators. Why not have a surgery simulator? Surgeons typically prepare for surgery by studying CT and MRI data. The possibility exists to create a 3D model of the data and provide it in an AR environment for the surgeon to examine. In a real world example, Dr. Giuseppe Turini has created simulators that allow doctors to practice abdominal procedures prior to wheeling a patient into the operating theater.

Surgeons can benefit from accessing information while looking at the surgical field. Rather than continuously glancing at a bank of monitors, surgeons could have the information within their field of view. Although this sounds insignificant, it’s preferable to have the surgeon’s eyes remain focused on the patient and the surgical instruments instead of a monitor hanging from the ceiling.

**Freelancers**

America’s workforce is transitioning into freelancers. In 2014, a Freelancers Union and Elance oDesk survey of over 5,000 workers estimated that 53 million Americans were freelance workers. That represented 34% of the American workforce. These workers added $715 billion to the U.S. economy. By 2020, up to 50% of American workers could be freelancers. Why is this important? Technology enabled most of these Americans to find work. Most are comfortable using it, so if AR explodes as we and others think, new Americans will be eager to use AR as a tool to improve their workflow. As well, with a generation of Boomers set to retire, some may seek to exploit their knowledge with AR to train and support less experienced workers.

Enterprises also benefit from freelancers. Facilities are the second biggest cost to enterprises (the workforce is the largest), and many facilities are underutilized. A freelancing workforce coupled with a flex workforce, where workers are given the option to work outside the office if
they choose, can reduce the amount of floor space enterprises require which, in turn, decreases facility costs.

Other Companies to Watch

Apple (NASDAQ:AAPL) nibbled away at the augmented reality space with its May 2015 acquisition of Metaio (private). Started in 2003, Germany-based Metaio counted 1,000 customers and 150,000 users across 30 countries. Apple would not comment on what it plans for its newly acquired technology, although we wouldn’t be surprised to see it implemented in tablets since many of Metaio’s videos show users engaging AR applications via tablets.

ARC4 saves lives. The Company has developed a smart glass monocle for soldiers. Today, soldiers access information via smartphones or chest mounted devices. Both of these require the soldier to look down, which leaves her vulnerable. With ARC4’s AR monocle, the soldier not only keeps her gaze upon the battlefield but also knows where everyone in her platoon is located. She can digitally mark certain targets and ARC4’s system conveys the position to everyone. The user interface was the most minimalistic that we saw at the show. This is important for safety since it is better for the soldier to glance briefly at his AR world and extract the info rather than have to search for it through graphic clutter. Again, this means more time is spent looking at the battlefield rather than the AR monocle information. Most important of all, management emphasized that ARC4 technology is not meant to replace the soldier’s thinking but complement it.

Augmented Pixels (private) 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.

Blippar (private) 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.

Cimagine (private) brings commerce to your pocket. The company’s solutions allow users to use mobile devices to visualize products in 3D. Cimagine lets shoppers virtually bring the store into their homes – even their pockets - to link the online and in-store shopping experiences in order to facilitate faster buying decisions. Marketers can use in-store Cimagine solutions to send virtual products to potential customers in targeted emails or via social networks.
Daqri (private) combines AR with safety helmets in its Smart Helmet. Targeting industrial markets, Smart Helmet’s camera array allows its computers to have a 360° view. Smart Helmet also has measurement capabilities and a high-resolution depth sensor. The unit allows workers to augment data over top of the actual work environment. It can integrate live data and present it to the worker; she could, for example, monitor a gauge from the other side of a manufacturing floor.

Marxent Labs (private) has built a holodeck. All that Star Trek science fiction stuff is now real. The CEO demonstrated the technology that Lowe's (NYSE:LOW) is using to let customers design virtual rooms. Using a tablet, he selected furniture and flooring products that Lowe’s sells, and arranged them on the tablet’s virtual world. Then, we slipped on a HMD and slid into the holodeck – Lowe’s uses a tablet - and saw the design come to life. Using a tablet, customers can change furnishings on the fly and purchase what they’ve designed. A fun, interactive (immersive with a HMD), marketing tool that we believe many retailers will adopt.

NGRAIN (private) connects enterprise workers to the right data at the right place and at the right time. Founded in 2000, NGRAIN empowers industrial field specialists to make decisions on-the-spot, maximize the operational uptime of their industrial assets, and eliminate costly mistakes. NGRAIN enables these benefits via its next-generation 3D volumetric rendering engine with integrated authoring software as well as desktop, mobile, and wearable apps.

We saw NGRAIN’s demo; it was impressive. The Company used a CAD file to create a 3D model of a pump. NGRAIN’s solution allowed the user to explode the parts and create 3D instruction videos that showed how to replace the pump’s air filter through a specific sequence of steps. NGRAIN also had the physical pump and repeated the air filter replacement video by pointing a tablet at the machine. The user was walked through the process of changing the air filter, which essentially makes the pump’s repair manual obsolete. Think of all the devices in your home that will need servicing one day. NGRAIN’s solution could save thousands of forests from the paper mill. But the Company’s potential doesn’t stop with industrial support applications; NGRAIN representatives shared that interest from the biomedical industry is growing.
OPS Solutions (private) demonstrated that AR does not require glasses. The Company’s Light Guide Systems solution is a pick and place system that projects light onto a series of bins to assist an assembly worker. A light flashes on a part bin; if the worker selects the correct part, the assembly process continues. However, if the wrong part is picked, an error message is generated. The system also identifies bottlenecks and can be used on any surface.

Osterhout Design Group (ODG) (private) is focusing on building smarter glasses to be the “hands-free computer of tomorrow.” ODG smart glass system offers: location awareness, communications (including Wi-Fi), personalization, and optics that deliver stereoscopic display on the equivalence of a 65-inch screen in front of your eyes. NASA has validated ODG’s smart glasses; it plans to equip astronauts with ODG’s smart glasses in order send instructions directly to astronauts’ eyes xxxii.

Qualcomm (NASDAQ:QCOM) has its Vuforia mobile vision platform for AR. More than 150,000 developers support it and have created upwards of 15,000 commercial apps. Qualcomm has a Vuforia software development kit for digital eyewear which allows 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.

VA-ST (private) is a start-up company developing computer-vision applications. In 2014, the founders won a Google Global Impact Challenge to evolve their Smart Specs into a product that people could use every day. Smart Specs captures depth information, removes background clutter, and “cartoonizes” the image with shadows and sharp contrast. These distinct features makes it easier for some legally blind people to recognize shapes and facial expressions.

Conclusion

Although augmented reality is in its early stages, it is real. All the pieces are in place; now the use cases need to be developed. The HMDs need further development in order for consumers to adopt them, but the enterprise is already using them. And the enterprise is where we’ll see mass adoption of AR first. Enterprises have servers filled with underutilized data, and software companies have written solutions to turn that data into useful information.
Acronyms Used in this Report

3D  three dimensional
AR  augmented reality
AWE Augmented World Expo
CAD computer aided drawings
CRM customer relationship management
ERP enterprise resource planning
FoV field of view
HMD head mounted display
MES manufacturing execution system
VR virtual reality
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