Virtual Reality (VR) and Augmented Reality (AR) have received a lot of attention in the last few years. This article studies the current state of the VR/AR penetration in the enterprise and highlights a few examples where these technologies have been successful.

As virtual reality (VR) and augmented reality (AR) technologies endeavor to find their place in the consumer space, their contribution to the enterprise is becoming increasingly clear. The benefits accrued are (a) cost reduction and faster times to market by reducing the need to develop physical prototypes and finding defects early, (b) the ability to inexpensively study and address human–machine interface (HMI) issues, and (c) easy enterprise-wide collaboration and training.

Upskill Technologies, working with GE, used Google Glass to demonstrate performance improvement of a user undertaking equipment maintenance tasks by 34%, in a first-time use of the technology.1 Other case studies from Boeing, GE Healthcare, and other firms have shown productivity improvements on an average of 32%. To put this in perspective, productivity growth in the US has averaged 0.5% from 2011 to 2016, compared to 3% from 1996 to 2005. Other notable examples include the use of Hololens at Japan Airlines to provide supplemental training for engine mechanics and flight crew trainees as well as Bechtel and Industrial Training International (ITI) partnering to train workers on operating cranes in VR.

We detail the expected future advancements below.

### REDUCED COST AND FASTER TIME TO MARKET

Building physical prototypes is expensive and time-consuming; replacing them with virtual prototypes allows for several iterations for the cost of a single prototype. This not only reduces cost but also makes iterations more efficient, thereby providing a faster time to market. As Jacques Delacour, CEO of OPTIS, a virtual prototyping company, puts it, “The goal is to have zero physical prototypes.”

Autodesk (Inventor, VRED), ESI Group (IC.IDO), and OPTIS (OMS2, SPEOS, Thea RT) all provide functionalities for VR in the enterprise, especially in the automotive and aerospace industries. Among these, OPTIS stands out for its focus on physically accurate simulations. For example, it treats light as multi-spectral energy rather than three-color channels, does a physically accurate simulation of light transport, and then maps the resulting energy into the device range by accurately simulating the human perceptual system. Among other things, it models

- The polarization of light required for simulation of glare.
• An average of about a 100 channels for light modeling, which can be decreased or increased depending on requirements.

• Mapping of high dynamic range energy information into the device range by simulating human perception. For example, OPTIS models glare depending on the person’s age and can predict who will be able to read the displays.

This year, OPTIS launched light painting with Theia-RT 2017 (see Figure 1).

![Figure 1. Theia-RT speeds up lighting design: designers paint the desired lighting, and the system automatically figures out the parameters of the lighting system. (Photo credit: OPTIS.)](image)

**ENABLING NEW APPLICATIONS**

Another area of advancement in AR/VR includes novel applications where none existed before or were even possible.

An example in this category is Aeroglass (http://glass.aero; see Figure 2), which provides a solution to pilots’ unique need to visualize terrain, navigation, traffic, instruments, weather, and airspace information, with access to vital safety procedures and protocols—all within the confines of a cockpit.

![Figure 2. AR navigation in a cockpit. Pilots can see aerial navigation data overlaid on top of their HMDs.](image)
This solution can be used with various head-mounted displays (HMDs) including Osterhout Design Group’s smart glasses (http://www.osterhoutgroup.com/products) and Epson Moverio, among others. The app won the best app of the Auggie Awards (http://events.bizzabo.com/AWE2017/page/1007706/2017-auggie-awards) at the Augmented World Expo this year.

Similarly, 8ninths developed a Holographic Workstation for stock trading (see Figure 3) for Citi Traders on the Hololens platform, which clearly demonstrates viable visualization and collaboration possibilities as the technology becomes more widely available.

![Figure 3. Stock trading using AR. The stock trader (top) looks at the visualization of stocks to find a desirable trade. He then discusses it with his client (bottom) who views the close-up of the visualization and gives a go-ahead to proceed with the trade.](image)

**IMPROVED IMMERSION**

A third area of advancement in AR/VR is the ability to provide better immersive experience by having a larger field of view, an untethered experience, or a multi-sensory experience, especially haptics. Even though the advancements in this area are primarily being driven by consumer VR/AR, the results will benefit the enterprise, especially when dealing with HMI.

In VR, a large field of view is extremely important to provide immersion. Among the current players, HTC Vive provides the best field of view with a horizontal field of view at 100°. Two new players are VR Union (http://vrunion.com; headset: Claire VR) with a field of view of 170°, and Star VR (http://www.starvr.com) with a 210° horizontal and 130° vertical field of view.

See the sidebar, “Further Resources,” at the end of the article for links to more tools and products in this area.

**CONCLUSION**

Whether VR/AR succeeds in the consumer space—and we certainly hope that it does—it is clear that it is here to stay in the enterprise.
REFERENCES


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SIDEBAR: FURTHER RESOURCES

A few companies provide add-ons to existing HMDs to make an untethered experience possible. Notable among these at the time of writing this article are TPCast (http://uploadvr.com/tpcast-wireless-vive-impressions), DisplayLink (http://www.displaylink.com/vr), and Sixa (http://www.tomshardware.com/news/sixa-rivvr-wireless-vr-tested,34064.html; Rivvr). The challenge is compressing the data streams, maintaining a low latency, while preserving a good experience. HP addresses the problem by putting the workstation in a backpack (HP Z VR Backpack G1 Workstation; http://www8.hp.com/h20195/v2/GetDocument.aspx?docname=4AA7-0460ENU).

Even though a few companies are exploring full body suits for haptics (for example, AxonVR [http://axonvr.com], Synesthesia suit [http://www.wired.com/2015/12/rez-infinite-vr-suit/], Rapture Vest [http://www.vrdb.com/hardware/rapture-vest], and Teslasuit [https://teslasuit.io]), for the enterprise Go Touch VR (http://www.wearable.com/vr/go-touch-vr-haptic-finger-accessory-7765), Tactical Haptic (http://www.roadtovr.com/tactical-haptics-2-2-million-seed-investment-grant-haptic-vr-controller), and Omnipulse (http://venturebeat.com/2017/05/14/cornells-haptic-skin-gives-vr-a-more-human-touch/) technologies may be the ones to watch because they may provide a better problem–solution fit.