From virtual to reality
Digital reality headsets in enterprise and education

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Overall spending on AR and VR headsets, software, and services, including purchases by consumers, rose in 2020 to US$12 billion globally, up 50% from 2019.[2] Although this figure is lower than the prepandemic forecast of almost 80% growth, it was much better than worldwide IT spending, which declined by more than 5% for 2020 year over year.[3] Postpandemic, higher growth is expected to resume for XR, with one group predicting the industry will reach a total of US$73 billion in 2024, or a 54% annual growth rate between 2020 and 2024.[4]

Although the predicted growth rate in headsets specifically is off a low base, with fewer than 100,000 VR, AR, and MR headsets purchased annually by enterprises and schools from 2015 through 2019, the upward trend appears clear.

Market growth for these types of headsets has already accelerated in some markets due to the risk of COVID-19 infection driving their use in teaching employees and students virtually rather than in person. With the pandemic accelerating the opportunity to demonstrate their value, digital reality headsets may continue to gain ground after the pandemic ends due to a variety of other benefits, such as lower cost, greater safety, and better learning retention.

XR's pivot to the enterprise market

Within the total XR industry, enterprise applications such as training and industrial maintenance were predicted to generate US$1.3 billion and US$0.4 billion in 2020, respectively.[5] These numbers are still smaller than consumer sales—but over the next few years, organizational purchases of XR will likely narrow the gap, with all of the fastest-growing digital reality markets expected to be in enterprise or education. Sales of XR for use in public infrastructure

HOW CAN A company train workers to unload hazardous materials, configure a wind turbine, or service a jet engine when a pandemic makes it impossible to teach and learn these skills in person?[1] One way to do it is to use virtual reality (VR), augmented reality (AR), and mixed reality (MR) to simulate those environments for workers to practice in. We predict that, led by purchases by corporations and educational institutions, sales for enterprise and educational use of wearable headsets for VR, AR, and MR—collectively known as XR or digital reality—will grow by 100% in 2021 over 2019 levels.

maintenance, industrial maintenance, and logistics and package delivery management are predicted to more than double every year from 2019 to 2024. And both post-secondary and K–12 lab and field spending on digital reality is expected to rise more than 120% annually over the same period.[6]

It may be surprising that organizational XR sales are expected to gain ground on those to consumers, especially in a time of pandemic when consumers might have flocked to VR headsets to alleviate the boredom of being locked down at home. (The consumer headset market is almost entirely for VR headsets, with AR and MR being primarily enterprise devices.) In tech blogger Ben Evans' memorable phrase, pandemic lockdowns were a kind of "forced experiment" for various technologies—including work-from-home tools, online grocery delivery, and home entertainment setups for gaming and video streaming—and VR seems a natural technology for consumers to add to the mix.[7] But although consumer VR did not collapse in 2020, neither did it surge. To quote Ben Evans again: "This should have been a [consumer] VR moment, and it isn't."[8] Consumers bought about US$2.9 billion worth of VR headsets in 2020, down 12% from US$3.3 billion in 2019, though sales are expected to rebound to US$3.5 billion in 2021.[9] That 2020 decline is better than what happened to cinema attendance during the COVID-19 lockdowns, which were down 66% worldwide for the year.[10] But it is less good than game console sales, which were up 150% annually in March 2020 as billions of people confined to their homes sought ways to entertain themselves.[11]

Given lower-than-hoped for growth in the consumer market, XR headset makers have been shifting to the enterprise. The first AR headset, Google Glass, was originally intended for the consumer market at its release in 2014, but it was relaunched in 2017 in a pivot to the enterprise market.[12] In April of 2020, Magic Leap announced that it too had decided to pursue enterprises as its primary market.[13] Microsoft's HoloLens has always been targeted at the enterprise, not the consumer. Even consumer VR companies such as Facebookowned Oculus and HTC started enterprise divisions in 2019.[14] There are rumors that Apple may launch AR and VR products in 2021—likely mainly for the consumer at first, but they may also have enterprise and education applications over time.[15]

Headsets, of course, are only part of a complete XR package. Adding up *all* the spending on enterprise XR, it is likely that the enterprise digital reality market generated revenues of US$13 billion in 2019, up 19% from the prior year. This number is larger than the total XR market mentioned earlier, as it includes internal R&D, which is large at this stage of the enterprise digital reality market evolution.[16] Determining the unit sales and dollar value of the headset portion only, excluding software, services, and internal R&D, is a difficult task: No XR makers disclose segmented sales in dollars or units on a quarterly or annual basis. But despite this difficulty, it is still possible to glean some information from occasional announcements by headset makers, enterprises, and educational institutions, as well as from media coverage.

Why aren't enterprise and education headset sales higher?

Between 2015 and 2020, there were dozens of different public announcements regarding enterprise and education digital reality. Deloitte Global has analyzed these public announcements and found some important trends.

HEADSETS ARE SHARED TECHNOLOGY, NOT PERSONAL

Although some enterprise technology tools such as the PC and the smartphone are personal (one per employee), other tools such as printers and LED projectors are shared among many employees: Tens or hundreds of employees use the same device as needed, and for only a brief period of time per use. The latter pattern of use is emerging as typical for XR headsets. For instance, in 2018, Walmart obtained 17,000 Oculus Go entry-level VR headsets, sending four units to all of its supercenters and two units to smaller locations. Using these 17,000 headsets, the company was able to train over a million employees on more than 45 different modules about new technology, customer service/empathy, and compliance. On average, almost 60 employees used each headset.[17]

NOT EVERY EMPLOYEE MAY NEED A HEADSET

It may be obvious that some types of workers, such as office workers, have little need for XR headsets. But even in jobs where digital reality headsets might be

useful, not every employee may require one. One of the more common uses for XR headsets in the workplace is to onboard new hires only, rather than using them to support existing employees.

NOT EVERY LOCATION NEEDS HEADSETS

The Canadian province of Saskatchewan has 1.2 million residents, 40% of whom live in remote areas. It has deployed two pairs of Google AR headsets in each of 11 communities so that onsite medical practitioners can consult in real time with experts in urban medical centers. The tool has proved "invaluable for wound treatment," according to Ivar Mendez, unified head of the Department of Surgery at the University of Saskatchewan.[18] But as useful as digital reality headsets can be in remote areas, they are not needed for such applications in urban areas, where a majority of the world's population lives.

HEADSETS MAY BE ONLY A SMALL PART OF A PROJECT'S TOTAL COST

The costliest publicly announced XR project to date is the 2018 US$480 million deal between the United States Army and Microsoft using the MR HoloLens.[19] This agreement was not for off-theshelf headsets, but for customized devices with thermal sensing and night vision used not just for training but on the battlefield as well. Although there have been discussions of follow-on orders for 40,219 headsets costing over US$2 billion over several years,[20] the initial deal covered only 2,500 headsets over two years. Even if these headsets cost 10 times more than off-the-shelf HoloLens units, or about US$30,000 each, the total hardware value of 2,500 headsets would be a mere US$75 million. In other words, the software, services, and development portions of the overall MR solution likely represented more than five-sixths of the total contract value, and the headsets themselves only about 16%.

DIGITAL REALITY HEADSETS ARE STILL IN THEIR EARLY DAYS, AND ARE MOSTLY USED IN PILOTS

More than half of the public announcements concerning XR headsets include the words "pilot," "trial," or "test." The training, enterprise, and education market for headsets is still relatively nascent, and it is, therefore, not surprising that individual companies and schools have only bought tens or hundreds of units. That said, as the Walmart

and US Army stories illustrate, follow-on purchases can be on the order of tens of thousands of units. Putting all of that together, the headset markets that are moving fastest right now are in immersive training, especially where real-world training would be dangerous, difficult, or expensive; for frontline health care workers;[21] for use in retail (consumer-facing, but still an enterprise use case); and for building digital reality strategies across the domains of hardware, software, and services.

What about education?

As mentioned earlier, the market for educational XR is poised to be among the fastest-growing XR segments over the next few years. Admittedly, this growth is off a very small base. Educational uses of digital reality have been embryonic between 2015 and 2020; according to one report, the global education XR market was only US$0.68 billion in 2019,[22] and the headset component of that (as distinct from software, content, and services) is likely less than US$100 million. Our research on headset announcements and partners uncovered no large education-specific pilots. Some small pilots do exist, but these use only a few headsets. For example, Brock University in Canada was using VR in classrooms prior to the pandemic, but it only has six headsets.[23] That said, as schools and colleges have been shut down due to the pandemic, XR and XR headsets are proving a valuable tool. As one example, a Canadian postsecondary institution is using VR for welding and automotive painting vocational programs, and has found the technology so useful and safe that it "will likely continue to use it when COVID-19 restrictions ease."[24] And one university in Kentucky has been teaching classes during the pandemic with HTC Vive VR headsets (although it has only 18 of them).[25] Other schools in California, Michigan, and Mexico also use a variety of digital reality headsets for MBAs and other programs.[26]

THE BOTTOM LINE

As enterprise and education XR headset sales grow, it is worth keeping in mind that these sales are likely to continue to represent a minority of total digital reality project spend compared to software, development, content, and services. Over time, however, the hardware component will likely grow as a percentage

of project value, as many of the other costs tend to be upfront while headsets become more material as pilots turn into full deployments.

What could boost enterprise headset sales even more would be if they follow the same trajectory as several other workplace devices. In the 1980s, some businesses had a single portable computer or radiotelephone/cellular phone for communal use. Over time, these devices became seen as so useful that every employee had to have their own, and price points dropped so significantly that doing so became affordable. A similar shift in both perceived utility and price for digital reality headsets could increase the market by 10 times or more.

It is unclear how XR headsets will fare postpandemic. It is possible that some of the enterprise and education use of digital reality headsets will be a blip: The headsets will be used during lockdown periods, and then discarded when things return to normal. However, for most organizations, it seems more likely that the COVID-19 period will be a crucible in which XR headsets prove their usefulness, spurring continuing growth. After all, if it's too dangerous, too difficult, or too expensive to train in the real world, why wouldn't you train in a virtual one?

Price will be one important factor spurring growth. It is anticipated that both existing manufacturers and new entrants will introduce high-quality digital reality headsets under the magic US$1,000 price point. Other reasons to anticipate increase in the use of digital reality include:

• Hard numbers on some enterprise VR programs so far show that they improve productivity by an average of 32%.[27]

• Academic research suggests that AR is better than video in workplace settings. Employees prefer it, their problem-solving improves, they make fewer errors, and they perceive it as more efficient than a standard video call.[28]

• AR training yields a 75% learning retention rate, higher than almost any other form of training. (Lectures and reading have only a 5%–10% retention rate.)[29] Another study showed that AR results in greater knowledge transfer and more than doubles learning outcomes.[30]

• VR appeals to a variety of learning styles,[31] and is especially useful for training that requires repetition and retention.[32]

• For learning in dangerous environments (such as for firefighters), VR is safer and less risky for employees and students.[33]

With VR, people do not need to travel to access training devices, and they do not need to bring heavy equipment to a special training location.[34]

If it's too dangerous, too difficult, or too expensive to train in the real world, why wouldn't you train in a virtual one?

Companies and educational institutions looking to deploy XR can consider several best practices:[35]

• **Make it impactful.** XR is about business outcomes and ROI, not about building shiny objects. Digital reality should solve problems in ways that were not otherwise possible.

• **Make it engaging.** Technology for technology's sake isn't helpful to anyone. It has to fit into the way humans work in order to achieve better outcomes.

• **Make it flexible and scalable.** A well-designed solution is built to evolve with new developments in the technology.

• **Make it work with change management.** XR is going to have far-reaching effects on workplaces and schools in the years to come, which will require new ways of working and thinking.

• **Make it easy.** Digital reality headsets should be more plug-and-play than they are now, especially for consumers, but also for enterprise and education.

• **Make it physically attractive.** Many early XR headsets were too large, uncomfortable, or ungainly.

Physical appeal matters even more for the consumer market, but it applies to both enterprise and education markets too.

Not all work and learning are suitable for XR—for example, to receive fine-grained tactile feedback when practicing surgery or delicate mechanical operations. Yet the future may see advances in haptics as the technology further develops.[36] And as it does, we can expect digital reality to become more widespread among businesses and educational institutions alike, transforming the way we get the job—or the learning—done.

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