Preparing the Enterprise for the Metaverse

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Initiatives: Collaboration and End-User Technologies for Technical Professionals

The metaverse does not yet fully exist, but it is beginning to emerge from immersive applications using currently available technology. Application technical professionals can position the enterprise for full participation in the metaverse by developing immersive experiences for their employees.

Overview

Key Findings

- Interest and investment in metaverse technologies are exploding, with spending over $120 billion in metaverse-related ventures in the first half of 2022 alone.
- Public-facing immersive experiences are difficult, expensive and risky. Inward-facing, employee-oriented immersive experiences are much more suitable to the present state of metaverse technologies and provide the most immediate value to the enterprise.
- Consumer-grade virtual reality (VR) equipment can only support the most basic metaverse scenarios. Advanced and high-value applications require a higher standard of equipment and software.

Recommendations

Application technical professionals wishing to prepare their enterprise for the metaverse should do the following:

- **Start with employee experience and wait on public-facing offerings.** Create internal immersive experiences to support employees and enable new capabilities. Immersive training is the simplest, least-expensive point of entry to the metaverse that also delivers high impact and immediate value.

- **Utilize inexpensive, consumer-grade tools first and progress to more capable gear.** Start with consumer-grade tools coupled with a packaged solution that can be deployed quickly and relatively inexpensively. Use the experience gained to assess, acquire and deploy more advanced and capable tools, including advanced headsets, scanners and haptics.

- **Pursue a minimum viable product (MVP) approach.** Select a small, well-defined and contained set of capabilities and a small set of initial users. Work with those users to establish requirements for an MVP. As users become more familiar and comfortable with the solution, new possibilities will be identified that can be added. This same principle applies when acquiring off-the-shelf solutions.

Analysis

Business leaders are very excited about the metaverse. Media speculation and vendor hype has whipped them into a frenzy of anticipation over an immersive digital utopia that does not yet exist. Luminaries like Mark Zuckerberg, Eric Schmidt and Satya Nadella are promising a complete transformation of digital experiences and unprecedented opportunities for those who get onboard. In response, executives are scrambling to secure their place, spending over $120 billion in metaverse-related ventures in the first half of 2022 alone. [1]

Much of this investment amounts to homesteading in the metaverse; staking a claim in uncharted territory and hoping things will work out. This mad rush puts technical leaders in a difficult position. They are being tasked with preparing the enterprise to participate in and profit from something that has yet to be fully defined, much less realized.

Even so, certain metaverse-enabling components are available today. Platforms for immersive streaming are available for collaborating in a shared virtual space. Design tools for creating three-dimensional and even immersive environments are now within the skill level and financial reach of even casual content creators. User experience hardware, such as VR headsets and haptic gloves, are moving from gaming curiosity to business necessity. Each of these tools and the emerging standards they are based on can be used now to prepare and position the enterprise to prosper in the fully realized metaverse as it emerges. If done well, these efforts can actually help the metaverse come fully into existence.

Defining the Metaverse

The idea of the metaverse originated with science fiction author Neil Stephenson in his 1992 novel Snow Crash, [2] where it is an all-encompassing, immersive, virtual environment. In this fictional world, people use avatars to interact with the metaverse to work, play and commit various cyber crimes. In the novel, much like the internet of today, if a business wants to thrive or an individual wants to interact with society in any way, a presence in the metaverse is mandatory. This is not the metaverse we have today, nor is it likely to be the metaverse to come.

> **"He is not seeing real people, of course. This is all a part of the moving illustration drawn by his computer according to specifications coming down the fiber-optic cable. The people are pieces of software called avatars. They are the audiovisual bodies that people use to communicate with each other in the metaverse."**
>
> *— N. Stephenson, Snow Crash, 1992.*

Gartner defines the metaverse as *"a collective virtual shared space, created by the convergence of virtually enhanced physical and digital reality. The metaverse is persistent; providing enhanced immersive experiences."*

This definition introduces subtle but important features often missed when considering the metaverse.

First, the metaverse is not necessarily a fully immersive, VR environment. Rather, it consists of both enhanced physical and digital reality. While some experiences may indeed be fully synthetic, immersive VR experiences, others may simply overlay digital information on the user's current physical environment as viewed through metaverse-enabled glasses or goggles.

Second, the metaverse is a collective space, not a single monolithic environment. It will consist of numerous, perhaps even innumerous, independent but interoperable applications and experiences. The metaverse itself will be a diverse ecosystem encompassing all of these enhanced experience applications, which can be thought of as *metaspheres*. These experiences should be able to interact more or less seamlessly across both hardware and software platforms. While the metaverse itself may not yet exist in its fully realized form, a wide variety of metaspheres are already in place and delivering value.

The Three Types of Metaspheres

A metasphere is simply an application that exhibits the characteristics of the metaverse, but largely in isolation. Currently realized use cases range from fully immersive training routines to unintrusive process instructions projected into the lenses of safety glasses. These applications are being realized with both industrial and consumer-grade tools. While larger enterprises often develop their own solutions in-house, system integrators and software development firms are emerging in this space to create custom metaspheres for companies without sufficient resources or expertise to go it alone. The metaspheres currently being utilized all fall into one of three categories: augmented reality (AR), mixed reality (MR) and virtual reality (VR).

Augmented Reality

A metaverse experience does not need to separate the user from their environment. In many cases, what is needed is additional data and information overlaid on that environment. AR applications use a display device, most often a mobile phone or tablet, to incorporate information into a real-time view of the user's current location. This is essentially an application of computer vision and search. Features of the environment, such as streets or buildings, are identified and pertinent information retrieved and overlaid on the image. For example, a user could point their phone at a street scene and the application would label each business in view and provide additional information such as hours of operation, price range, ratings and reviews. The overlaid information relates to the current location but is in no way intended to act as part of the location.

Mixed Reality

MR applications blur the line between the current real-world environment and digital additions to that environment. In most cases, light detection and ranging (lidar) is used to map surfaces, allowing the application to superimpose synthetic media on the scene. The digital additions are intended to seem like a physical object actually present in the environment. For example, Apple TV has recently used this technique as a promotional tool for the television series “For All Mankind.” Using an iPhone, a user can scan a flat surface, such as a desk or tabletop, and interact with various space vehicles as though they were physically present on that surface. MR applications are particularly useful in collaboration scenarios where an object is too complex or abstract to adequately represent on a flat computer screen. Multiple users can share a physical space, such as a conference room or laboratory, and interact with a wholly digital object as though it were physically present in the room with them.

Virtual Reality

Where MR metaspheres exploit and enhance the physical environment, VR seeks to replace it altogether. VR immerses the user in a fully synthetic experience and attempts to subvert the physical constraints of the real-world environment. VR headsets, motion sensing hand controls, haptic feedback gloves and multidirectional treadmills can all be used to create physical sensations in a virtual experience. VR evolved primarily for gaming but has recently been applied to training, design, collaboration and immersive entertainment. Full VR metaspheres are by far the most difficult to create and sustain, but they have also proven to be the most effective medium for several high-value use cases. This is especially the case when the scenario would involve high risk if attempted in the real world.

Numerous manifestations of all three types of metasphere are already in production use across a wide variety of companies and industries. Some use cases are more successful than others. Public-facing, consumer-oriented applications in particular continue to struggle. Among the most spectacular failures was a fully immersive VR concert of the pop band Foo Fighters hosted by Meta, the rebranded Facebook parent. The much-hyped concert intended for Meta Quest 2 VR gear owners succumbed to a plethora of technical issues. Of the 61,000 registered attendees, only 13,000 were able to access any portion of the event. Those that were able to view at least some of the concert were savage in their reviews of the experience. As one technology writer commented, Meta’s Horizon Worlds platform “fumbles at the first hurdle.” [3]

While not all public-facing metaverse ventures fail to the extent of the Foo Fighters' concert, they are without exception difficult, expensive and risky to stage. In addition, outside of gaming and promotion few practical and monetizable consumer-oriented use cases have been identified, much less implemented and deployed.

In time, consumer-oriented metaspheres will emerge, mature and converge into a fully realized metaverse. We just aren't there yet.

How to Get Started in the Metaverse

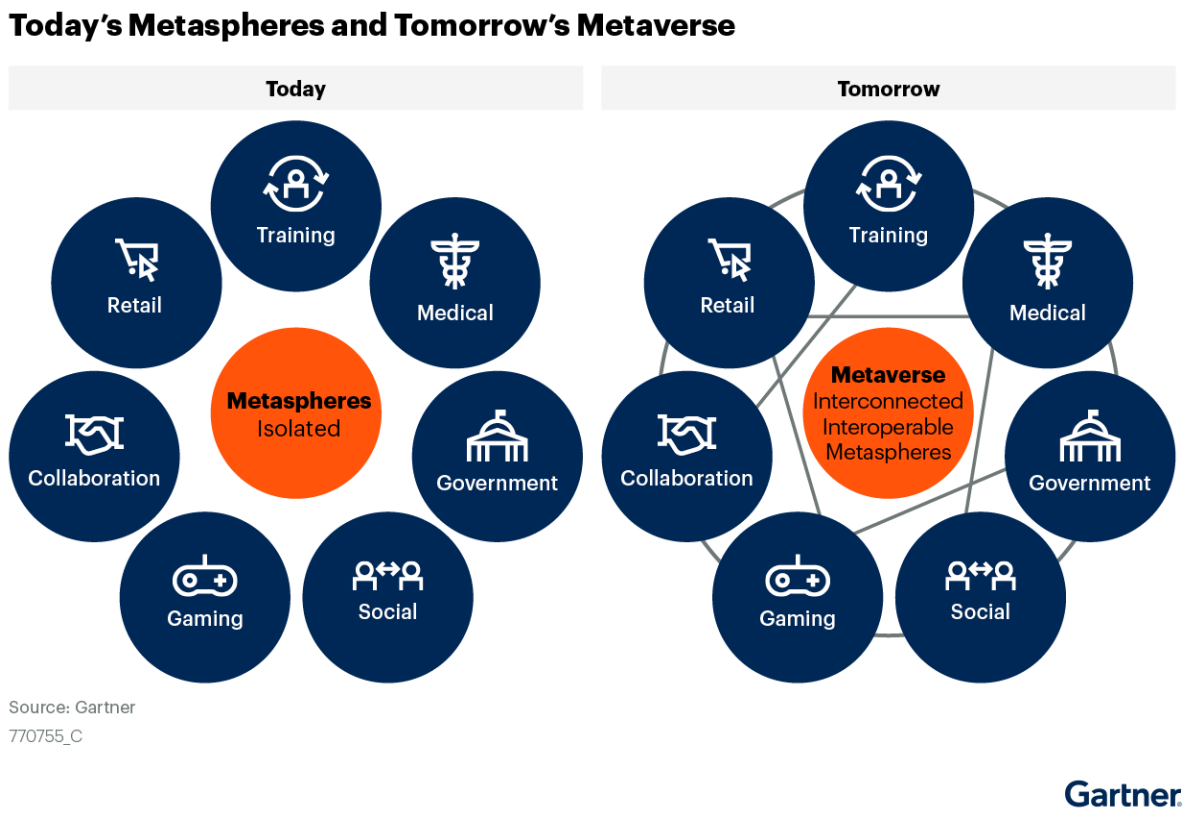
So where are metaverse technologies bringing value? Within the walls, virtual or otherwise, of the enterprise. Companies are preparing for the metaverse by exploring how the above-mentioned tools can benefit their employees, their operations and ultimately their bottom line.

Creating internally facing metaspheres has many advantages over attempting to field public-facing services. First and foremost, the enterprise is a controlled environment. Even when leveraging services hosted outside the enterprise data center, you control who has access, when and to what extent. Most of the failures with public-facing metaspheres involve scalability and capacity issues, with services (such as the Foo Fighters concert) being overwhelmed and crashing. Keeping the metasphere in-house allows you to throttle demand and scale computational resources as necessary and as desired to achieve your goal.

Employees are also somewhat of a captive audience. You can select a specific pool of users to provide a particular metasphere that will benefit both them and the enterprise. You can have those users test various approaches to a solution and provide feedback in a way that is not possible with the public. This has the added advantage of keeping your mistakes and failures out of public view while you gain competence and experience in what is decidedly a new discipline using new technologies.

This experimentation is perhaps the biggest benefit of starting with internally facing metaspheres. It allows you to learn both the tools and how they can most effectively be applied, and to do so at the enterprise's own pace. While the market sorts out how to monetize public metaverse offerings, internal metaspheres can provide immediate, practical benefits to the enterprise and potentially identify services that can indeed be made public and monetized. As more and more of these repurposed metaspheres emerge, they will converge and coalesce. From this network of interconnected and interoperable metaspheres, the metaverse proper will emerge. But this can only happen if use cases are selected wisely and implemented properly (see Figure 1).

Figure 1: Today's Metaspheres and Tomorrow's Metaverse



Metasphere Use Cases

When selecting a metaverse use case, the first and most important question to ask is: "*What will a metasphere enable us to do that can't be done with a laptop and webcam*?" Too many business leaders succumb to fear of missing out (FOMO) when new tech trends emerge and demand that something — anything — using the new tech be implemented immediately. This is especially true when a new trend is as overhyped as the metaverse. It leads to wasted investment, missed opportunity and disillusionment about the new landscape. Avoid this by selecting use cases carefully and evaluating the technology critically.

Do not give in to FOMO. Ask yourself: "What will a metasphere enable us to do that can't be done with a laptop and webcam?"

Consider each type of metasphere currently available — AR, MR and VR — and align them with scenarios that will improve business operations and employee effectiveness. Despite the newness of metaverse technologies and immaturity of their application, a significant body of practice has emerged applying these tools and techniques to employee experience. These applications can be grouped into four general categories: collaboration, training, documentation and support, and digital twinning (see Table 1).

Table 1: Use Cases and Metasphere Types

Use-Case Category ↓	*Metasphere Type* ↓
Collaboration	Mixed Reality
Training	Virtual Reality/Augmented Reality
Documentation and Support	Augmented Reality
Digital Twinning	Virtual Reality/Mixed Reality

Source: Gartner

Collaboration

With remote and hybrid work now the norm, immersive collaboration spaces are an obvious application of metaverse technologies. The promise of a sense of presence and shared space for geographically dispersed colleagues is appealing to both executives and staff. In addition, immersive collaboration solutions are one of the few "off-the-shelf" metasphere solutions currently available. While this makes collaboration metaspheres easy to deploy, meaningful connection and collaboration experiences remain difficult to deliver.

Mesh for Microsoft Teams is among the first of such off-the-shelf offerings. It is deployed as an extension of Teams and can be accessed with standard computer screens, mobile devices or VR goggles. In its most basic form, Mesh for Teams simply adds animated avatars and backgrounds to standard Teams meetings. In more advanced deployments, users' avatars can move about and interact within a 3D environment. This is a good example of "What does this enable us to do that we couldn't do outside of a metasphere?" Unfortunately, the answer in this case is "not much."

Replacing live images with avatars in a Teams meeting session adds an additional layer of abstraction and separation between users. Rather than helping people to connect, the cartoonish representations serve as little more than distractions. Fun initially, irritating eventually. The additional layer between users masks both facial expression and body language, making it more difficult to communicate and connect.

Similar issues arise when deploying 3D meeting spaces, but here an additional layer of abstraction is added in the form of controlling your avatar as it interacts with the space. At the present time, the overwhelming majority of users experience these 3D collaboration spaces through two-dimensional screens. Rather than interacting with other users from the perspective of your avatar, you see your avatar as an outside observer. These "third person" interactions put you at an additional layer of remove from the people you are intended to connect with. In addition, you must control your avatar like a character in a video game as it moves about and interacts with the environment, further distracting from other participants, the content being presented and the business at hand.

To realize true differentiating value from metaverse collaboration, you must move beyond basic meetings and interactions. Enable users to interact in ways and with objects that would not be possible in the physical world, even if all participants were physically present in the same space. In most cases, this involves a digital representation of a complex object such as a machine or medical scan, but can also include more abstract elements such as a visualization of a complex dataset or network graph. Users can interact with these virtual objects in a 3D, positionally aware manner that isn't possible on a flat computer screen. Layers of a brain scan can be explored, and components of an engine added, removed, reconfigured and examined from all angles at once. This enables design and experimentation free of the constraints of both screens and physical materials.

The next iteration of metaverse collaboration brings together shared interaction with virtual objects with high-fidelity presence. "Holoportation" is the real-time projection of photo-realistic representations of users participating in a meeting. Rather than an avatar, a user is continually scanned and projected into the environment as a hologram of their actual appearance. This was demonstrated in October 2021 when NASA flight surgeon Dr. Josefk Schmid holoported onto the International Space Station using Microsoft's HoloLens 2. Holoportation will be used on the space station for "private medical conferences, private psychiatric conferences, private family conferences and to bring VIPs onto the space station to visit with astronauts." [4]

Holoportation remains a research project in Microsoft labs due to the specialized equipment required to capture and project holographic representations in real time. At present, there is no public timeline for when it will be generally available. Cisco, by contrast, has a holoportation product, Webex Hologram, in private preview with a small number of companies. One British automotive manufacturer is using Hologram to build cars tailored to the customer's height, by virtually placing the customer in the driver's seat and aligning features to their height. This allows for an exact fit without requiring the customer to travel to the factory. Complex custom parts are assembled by hand at multiple remote facilities. Hologram allows engineers at one facility to review parts assembled at a different facility without needing to travel to that remote location. Webex Hologram requires specialized Cisco hardware to capture user images.

In all of these scenarios, the visual mediator — that is, the headsets such as the Microsoft HoloLens 2, Varjo XR-3 or the long-rumored Apple Glasses — is essential. Mixed reality frees users from flat screens by enabling them to make full use of their physical environment. Walls, desks, tables or any other open space can be incorporated into the experience as a platform for information. This means the headset must be able to sense and map both the physical environment and the user's head movements within that environment. It must also either superimpose digital content onto the user's actual sight of the environment, as with the HoloLens, or use cameras to capture the environment, incorporate digital elements and project the final product onto the user's visual field, as with the XR-3. The HoloLens approach is simpler and cheaper, but the XR-3 approach results in a more seamless experience.

Headsets capable of adequately supporting MR collaboration are not cheap. Microsoft's HoloLens 2 costs $3,500 for the basic edition and $4,950 for the Industrial version. A single Varjo XR-3 costs $5,995 and requires a $1,500 annual subscription. This does not account for the design software (discussed below), nor the collaboration platform. Inexpensive, gaming-oriented headsets such as the Oculus Quest 2 from Meta can be used for basic collaboration, but nothing beyond that. Bring your own device (BYOD) rarely has a place in business collaboration in the metaverse.

Metaverse collaboration is a good example of the adage "You get what you pay for." Basic metaverse collaboration centered on cartoonish avatars and experienced through gaming hardware provides no value to the business whatsoever. In fact, it may be detrimental to productivity and collaboration for the reasons previously described. MR collaboration, integrating physical space with virtual content, requires considerable investment, but can bring extraordinary value by enabling collaboration and innovation that would not otherwise be practical or even possible. Select high value use cases and make the necessary investment. Provide appropriate hardware to geographically remote experts or specialists and enable them to interact and collaborate on high-value projects. Don't waste investment and attention on simply animating your team meetings.

Training

Not all metaspheres require high-end hardware for users to participate in high-value use cases. Immersive training can, in many cases, be extremely effective with basic, consumer-grade headgear like the Oculus Quest 2, HTC VIVE Pro 2 or HP Reverb G2. This is because most training scenarios do not require mixed or augmented reality, but instead are most effective in a completely virtual environment. The value of immersive training is to place the user in an environment or situation that would be impractical or inadvisable in the real world. These use cases have the added advantage of commercial off-the shelf solutions being readily available, eliminating the need for development and implementation effort.

Vendors like Axon, VirTra and WRAP provide immersive environments for police to train in de-escalation and crisis intervention techniques, as well as field and tactical training. Such training in a metasphere is proving to be effective. The Phoenix Arizona police department deployed 200 headsets to their officers and used the Axon platform to provide de-escalation training. A study from the National League of Cities looked at 85 officers in Phoenix PD's South Mountain Precinct, which took nine modules of the training. Of those who participated, 81.4% said it was "effective" in helping them adapt to a call. In addition, more than half of those said the training encouraged them to look at calls from another perspective. [5]

Immersive training does not need to be restricted to high-stakes situations like law enforcement and crisis intervention. Training in a metasphere is particularly effective in helping employees cultivate soft skills. When business can be won or lost in a single interaction with an employee, it is wise to let that employee practice in front of an angry avatar before putting them in front of an angry customer. Strivr uses consumer-grade VR equipment to provide a range of immersive soft skills training ranging from customer service and sales to onboarding and diversity, equity and inclusion (DEI).

Training in a metasphere has numerous advantages over traditional approaches to training. First and foremost, when done well, immersive training works. In one study, VR-trained students showed a 250% improvement in their ability to accurately complete a safety procedure. [6] Nicklaus (formerly Miami) Children's Health System found that students who trained using VR were able to retain nearly 80% of what they learned when tested after one year, whereas students who trained using traditional methods retained only 20% a week after being tested. [7] That is effectively a 400% improvement in retention.

Immersive training is also less expensive and time-consuming than traditional training. A 2020 study of cardiology residents found that immersive VR training is 83% less expensive and 50% faster than traditional in-person simulation. [7] Walmart reports an 80% savings in training time for store managers preparing for Black Friday. As a result, Walmart plans to roll out VR education to 200 training centers. [8]

Finally, users simply prefer training in metaspheres. When surveyed following the use of virtual reality and traditional methods to teach technicians on a factory floor, over 85% of respondents expressed that they preferred learning in VR as compared with traditional methods. [7] Immersive training can also increase team cohesion by enabling remote employees participate in joint exercises without having to physically gather in the same location.

Haptics

While many training scenarios can be accomplished with basic, consumer-grade hardware, some situations require more advanced equipment. The biggest obstacle to providing realistic training are the controllers used to interact with the space. Most solutions depend on the simple wand controllers used in VR games. While these are more than adequate to move around a virtual space or to select options from a menu, they do not allow the user to directly manipulate virtual objects in the metasphere. For example, the user can rotate the controller to turn a knob or dial, but they cannot actually grab the knob and turn it. In addition, these simplistic controllers do not provide any physical sensation or feedback. The user cannot tell by touch how much pressure they are applying to a virtual object or how heavy it is. This sort of feedback requires haptics.

Haptics, or more formally kinaesthetic communication, provide the user with physical sensations that match their perceived experience in a virtual environment. For example, when a user picks up an object, they should feel its heft or when they push against a door they should feel resistance as it opens.

Haptic feedback mechanisms are the least mature of metaverse technologies, but they are advancing rapidly in quality and variety of experience. Currently, the most common form of haptic device are gloves that provide physical feedback to the user's hands. A wide variety of haptic gloves are currently available on the market that provide a range of sensations.

At the low end, products like CaptoGlove, Noitom's Hi5VR Glove, and VRfree gloves by Sensoryx are aimed at consumers and gamers. These gloves provide motion capture and individual finger tracking. While these do not provide physical sensations and feedback, the added granularity of tracking each finger enables the user to interact with their environment in a much more natural manner than is possible with the wand controller. If the user is training to use a particular piece of equipment or to perform a task that requires physical dexterity, such as packing a box or treating a wound, these inexpensive gloves are indispensable to training scenarios.

At the other end of the capability spectrum are products like the HaptX Gloves DK2 and the VRgluv ENTERPRISE. These gloves are targeted at both metaverse and robotics applications and provide nuanced, physical sensations to the user's hands. VRgluv is capable of generating up to 10 pounds of active force feedback on each finger to simulate the size, shape, stiffness and impact of a virtual object. Integrated force sensors track resistance in the user's fingers to enable them to handle and manipulate virtual objects with realistic physical sensations. This is essential for training scenarios that are intended to develop muscle memory in the user.

HaptX takes haptic feedback a step further. In addition to resistance and pressure, the HaptX Gloves DK2 use microfluidic skin to provide over 130 points of haptic sensation per hand. Tactile actuators displace skin up to 2 mm to apply specific, subtle pressure to produce the expected sensation in response to the perceived experience of the virtual environment. These fine-grained sensations are combined with broader feedback, up to 40 pounds per hand, provided by a force feedback exoskeleton driven by precision-forced air pneumatics. The microfluidic actuators, combined with the force and resistance exoskeleton, enable the user to practice a skill or procedure in as realistic a manner as is currently possible without the risk of learning in the real world.

Immersive training is the simplest, least expensive point of entry to the metaverse. It is also the most effective at delivering high impact and immediate value.

For the vast majority of organizations, employee training is the place to start when exploring ways to engage with the metaverse. Begin with off-the-shelf training packages that require only consumer-grade VR goggles and controllers. Most vendors will modify and adapt their solutions to a given customer's specific needs. This will enable you to gauge how metaverse technologies will be received by your employees and your corporate culture as a whole. It will also help you make more informed decisions when formulating a strategy for engaging with customers and the public in the metaverse at large. If immersive training proves to be a good fit for your corporate culture and priorities, expand into higher-value, higher-risk training scenarios. The added complexity and expense of haptic feedback mechanisms and more detailed environments will be more than recouped in the ongoing reductions in risk and training expense, while at the same time improving training outcomes and knowledge retention.

Documentation and Remote Expertise

Even highly trained staff still need to consult documentation when working problems and solving issues. Finding and accessing the right information can be challenging even when sitting at a desk or in a call center. It becomes much more challenging when in the field away from office resources and often with both hands fully occupied. Augmented reality solutions address this scenario by providing hands-free access to documentation and projecting that information into the user's field of vision. Documentation and support metaspheres can go far beyond simply projecting a PDF of a systems manual into a VR headset. They can map instructions and illustrations onto the situation at hand, guiding the user step by step through the current activity.

This sort of in situ support is a key use case for several current AR smartglasses, including Google Glass 2 Enterprise, Microsoft HoloLens 2 and the RealWear Navigator. Each of these platforms are in current use in a variety of environments and use cases. For example, physicians are using Google Glass during patient visits to enable them to review and update medical records while still giving the patient their full attention. Technicians use RealWear Navigator to access engineering documents while servicing equipment on a factory floor.

Smartglasses like Glass and Navigator are not stand-alone devices. They pair with a mobile device to provide connectivity and additional processing power for whatever app is currently being used. Most operations are conducted by voice command utilizing a microphone built into the headset. While simple commands, such as to launch an application or record a scene with the integrated camera, are relatively straightforward, the hands-free nature of smartglasses illustrates a particular challenge and opportunity unique to metaverse applications — finding, retrieving and accessing information solely by voice command. This makes enterprise search and knowledge management central to any documentation and support scenario.

Effective enterprise search is challenging under the best of circumstances. Hands-free, voice search further complicates the matter. As anyone who has made a request of Amazon (Alexa), Microsoft (Cortana) or Apple (Siri) can attest, voice-driven search remains a hit-and-miss proposition. The user must properly formulate and articulate their request. The app must interpret the user's voice and translate it to a machine-interpretable command. The search engine must execute the query and return results that the user can review and access, again by voice command.

As visual search technologies continue to improve, the dependency on voice search will diminish. Computer vision with object detection and recognition can reduce much of the query formulation burden by identifying objects in the user's field of vision and retrieving relevant content. Such services are available as part of Amazon Web Services (AWS) Image Recognition Services, Microsoft Azure Cognitive Services, and Google Perception. Search platform vendors offer native visual search capabilities that can be incorporated into metasphere search applications. At this point, the object recognition capabilities of these platforms are targeted and trained for common objects and, in some cases, famous individuals. To be truly useful in an AR support and documentation situation, they would require training and tuning specific to the use case at hand, such as recognizing specific components of a particular machine.

To make this process reliable to a metasphere user in the field using either voice or visual search, enterprise search must be implemented and maintained in an optimal state. Most organizations continue to struggle with providing adequate search on the corporate intranet or website. Preparing search for the metaverse will require additional effort and investment. Fortunately, this will have the added benefit of improving search for the enterprise as a whole and thus improving overall efficiency and effectiveness of staff both within and outside of the metaverse.

Even the best implemented and maintained voice search capability will not be useful if the required knowledge and information hasn't been captured and curated. Effective knowledge management is an essential supporting function to ensure the right information is available. Processes must be in place to capture knowledge and expertise in a manner that will make it readily discoverable by a voice-driven search engine. Standard knowledge article structure, metadata and life cycle management are essential to enable documentation access.

The knowledge management process also extends beyond creating and maintaining a knowledge base or indexing documentation on a file share. It is essential to know who knows what in the enterprise. A searchable expertise will make live, remote expertise available to the metasphere user in the field. For example, if a technician encounters a situation they are not qualified to address, a remotely located expert could be contacted to assist. Smartglasses and headsets have integrated cameras that will let the remote expert see exactly what the person on site is seeing in real time. They can then provide guidance or even walk the on-location person through what needs to be done.

When remote expertise is combined with a full augmented or mixed reality headset like the Microsoft HoloLens 2 or Varjo XR-3, the remote expert can overlay information directly on the scene. A problematic component could be circled or highlighted. An animation of how to orient a particular widget could be superimposed on the widget itself. If using holoportation or even avatars, the experts themselves could be projected into the scene to walk through the process or point out items of interest. Not only will this help resolve the issue at hand, but it will facilitate considerable knowledge transfer between the participants.

Developing remote experts for in-house support can help prepare the enterprise for participation in the metaverse by providing a direct path from employee experience to customer experience. Consider a typical contact center or help desk customer interaction. Rather than asking the customer to describe the situation, a support agent would be able to see exactly what the customer is seeing in real time. Rather than just talking the customer through the resolutions, step-by-step instructions and illustrations could be overlaid onto the customer's field of vision. This will not be practical until consumer-grade smartglasses are ubiquitous, but starting with internal support will ensure that the enterprise's AR support becomes the expectation rather than the differentiator.

Digital Twins

Building new things and moving them around in the real world is difficult, expensive and risky. A new factory configuration may seem perfect on paper and be completely unworkable when the machines and people are actually put in place. Turning an untrained employee loose on a complicated piece of equipment is dangerous both to the employee and the machine. Surgeons need to practice on countless dummies and cadavers before cutting into an actual person for the first time. Digital twins provide a virtual solution to these physical challenges.

A digital twin is a virtual representation of a real-world entity such as an asset, person, organization or process. These virtual objects can also be complex systems composed of multiple, interacting digital twins each updated with real-time data from business systems or Internet of Things (IoT) devices. Most digital twins currently created with platforms such as AWS IoT TwinMaker, Azure Digital Twins and MATLAB are primarily mathematical models of systems and deliver data rather than a visual or physical representation. But this is beginning to change as metaverse technologies mature, with digital twins populating virtual environments that users can move through and interact with.

BMW Group partnered with NVIDIA to create a digital twin of a complete automotive factory using the NVIDIA Omniverse platform. This enabled teams located around the world to map the entire production process of a physical car factory into an accurate and operable 3D representation. BMW and NVIDIA engaged reality capture firm NavVis to use mobile 3D laser scanners. These scans will be used to create photorealistic panoramic images, floor plans and scatter plots for all BMW Group vehicle plants, including all building structures, facilities and outdoor areas. [8] This data will be used to create digital twins within the NVIDIA Omniverse platform.

The primary goal of the BMW digitalization effort is factory planning. BMW produces 2.5 million cars a year and 99% of them are customized. With 100 options for each car and more than 40 BMW models, there are over 2,000 ways to configure a new BMW. [9] By creating a metasphere that replicates the factory and its production lines, factory designers and managers can simulate different configurations and processes virtually before making changes in the physical factory. This allows various scenarios to be tried and tested in order to ascertain the most efficient way to produce cars.

Digital twinning isn't restricted to inanimate objects and machinery. NVIDIA created digital humans trained on real employee behavioral data to populate the simulated BMW factories. These digital humans can be used in simulations to test new workflows for worker ergonomics and efficiency. This is especially important in designing how flesh-and-blood humans interact with assembly line robotics. Overall, BMW is anticipating a 25% reduction in the time it takes to plan out factory configurations and operations.

Digital twin metaspheres are not restricted to large-scale industrial operations. A team of doctors in Poland used the Unity 3D development platform to create a digital twin of a fetal heart for training purposes. Normally, detecting a congenital defect in a fetal heart requires bulky and expensive sonography equipment which most medical schools do not have. As a result, few medical students receive hands-on training in fetal heart diagnosis and care. Fetal Heart VR allows doctors to guide a probe across a belly-like dome in order to study normal and abnormal beating fetal hearts, re-created identically from real-life scans, through a VR headset. Fetal Heart VR is available as a download through the Oculus AppLab Store and can be used with consumer-grade VR equipment.

Most digital twinning metaspheres in the enterprise will lie somewhere between the complexity of an automotive factory and the fragility of a human heart. Replicating a basic assembly line tool like a drill or a deep fryer in a restaurant kitchen will enable workers to acquire and practice a new skill without risk. Re-creating a work environment in virtual space could allow a job applicant to demonstrate proficiency at a task from home or a remote office before flying them in for an on-site interview. Again, the question for digital twinning is "What will a metasphere enable us to do that we couldn't do otherwise?"

The use cases do not need to be elaborate to get started or to create value. The tools necessary to create interactive digital twins are becoming less expensive and more accessible than ever before. Services like Azure Digital Twins and AWS IoT TwinMaker are providing inexpensive support for the data and modeling layer, while visual design and rendering platforms are moving into the consumer realm.

Adobe's acquisition of Allegorithmic in 2019 added metaverse capabilities to its creative cloud. Allegorithmic brought with it the Substance 3D Modeler, which enables the user to sculpt 3D objects using digital clay within an immersive workspace. The tool also provides more traditional tools familiar to Photoshop and Illustrator users that facilitate more precise and complex operations. Substance can create digital twins to populate a metasphere or create the environment itself. The Allegorithmic acquisition also led to the production of Project Aero, targeted explicitly at AR applications. Aero enables the user to create digital objects and experiences to be overlayed on a physical space. Like other creative cloud tools, Aero requires no coding.

Working within familiar platforms like Adobe, Unity or Unreal Engine, and combining them with cloud digital twin services like AWS and Azure, provides an opportunity to gain experience with metaverse scenarios without significant risk or expense.

As a technical professional, you should leverage existing creative talent and data expertise that likely exist in-house. Select a simple real-world object or simple system and replicate it. Even if this creation does not find its way into a production metasphere that you acquire or have built by a contracted agency, the experience gained will enable you to make better-informed decisions, better communicate with the contracted agency and better position you to develop your metaverse strategy.

Strengths

While the metaverse itself remains firmly in the future and many of its supporting technologies are immature, applying those technologies now to employee-facing services has many advantages. Chief among these are the following:

- **Risk, complexity and expense can be controlled by the organization.** As repeatedly demonstrated by failed public metaverse undertakings, consumer-oriented, publicly accessible immersive experiences are difficult, expensive and risky. User demand and expectations are entirely beyond your control, as is the equipment the consumer will use to access your offering. By keeping the metasphere in-house, you eliminate the risk of public debacles that are currently more likely than not with public metaverse offerings. You determine which use cases will benefit the enterprise and its employees the most, scale it to your available resources and desired timeline, and choose your users according to your goal. If a project fails, it is a learning experience for everyone involved with no need to do damage control with the company's brand and customers.

- **Employee-facing metaspheres can bring ongoing value independent of the final state of the metaverse.** Perhaps the greatest unanswered question about the metaverse is "How do we make money with it?" Beyond gaming and entertainment (and very narrow slices of those markets at that), practical ways of monetizing the metaverse have yet to be identified. But metasphere technologies are already in place and generating value by improving business efficiencies and expanding capabilities. Training, collaboration, support and digital twinning are currently in use across a wide range of industries and have proven their worth in these employee-centric scenarios.

- **Developing employee metaspheres will provide experience with metaverse technologies and position the enterprise to help shape the metaverse.** Metaverse tools, platforms and use cases are new and nascent. It will require a new skill set to be viable on either side of the firewall. This applies to both technical and nontechnical professionals. As competence and comfort with this new environment develops among staff involved in developing and adopting metaspheres, the enterprise's preparedness for engaging the public in the metaverse will improve. That experience will inform your metaverse strategy and enable you to engage with the dynamics that are shaping the metaverse as it coalesces.

Weaknesses

Despite the potential for employee-oriented metaspheres, engaging with and investing in metaverse technologies is not without weaknesses and risks. Chief among these are the following:

- **The metaverse does not yet exist, and there are many unsettled issues and unanswered questions.** Even though metaverse technologies are available, in use and delivering value within the enterprise, the eventual form and function of the metaverse itself remains to be seen. The metaverse is often conflated with Web 3.0 as the next iteration of the internet. The actual successor to the current network of networks may take a completely unanticipated form and require completely different tools and skill sets. Investing heavily solely for a potential entry into the public metaverse when it emerges is very risky. This risk is mitigated considerably by keeping things within the enterprise until the metaverse is more fully formed.

- **Many current metaverse-related tools can distract, rather than bring value.** Many vendors touting themselves as metaverse providers are leaning heavily on providing a novel experience rather than new capabilities and actual value. Simply replacing a live video image of a user with a cartoonish avatar does not enable closer connections among colleagues, nor does it make meetings more productive. On the contrary, they provide passing amusement at best and an additional layer of separation at worst. In addition, clunky controllers such as keyboards and VR wands further separate the user from the business at hand. Trying to navigate a pseudo-immersive environment, such as a virtual meeting space experienced on a laptop screen or mobile device, adds to the user's cognitive burden, further distracting from the business being conducted. Collaboration metaspheres should be reserved for high-value, advanced collaboration scenarios that would not otherwise be practical or possible.

- **Metaspheres require either a new skill set with new technologies or dependence on contractors and agencies.** While some skills, such as IoT digital twinning and visual design, are directly transferable to metasphere development, most of the necessary skills will be new and likely unavailable in the enterprise. This will require either training up internal staff or hiring rare and expensive new talent. Most organizations will instead opt to engage contractors or specialist agencies to develop their metaspheres. While this may ultimately be the most practical and cost-effective approach, it also creates an ongoing dependency between the enterprise and outside agencies. This will introduce ongoing expense and risk that would not otherwise be necessary.

Guidance

Technical professionals wishing to prepare the enterprise for the metaverse should do the following:

- **Start with employee experience and wait on public-facing offerings.** While waiting and watching for the metaverse to emerge, start preparing by creating internal immersive experiences to support employees and enable new capabilities. When considering use cases, always remember to ask "What will this enable us to do that can't be done more simply with a laptop and a webcam?" Avoid simplistic applications like avatar-based collaboration that provide more novelty than capability. Metaspheres for training are the simplest, least expensive point of entry to the metaverse. They are also the most effective at delivering high impact and immediate value. For the vast majority of organizations, employee training is the place to start when exploring ways to engage with the metaverse.

- **Initially utilize inexpensive, consumer-grade tools and progress to more capable gear.** Your first investment in metaverse software and equipment should not be high end or elaborate. Start with consumer-grade tools like the Meta Quest 2 or HTC VIVE, coupled with a packaged solution that can be deployed quickly and relatively inexpensively. In addition to minimizing the necessary initial investment, these lower-end tools are more likely to be familiar or at least less intimidating to users. Use these inexpensive tools to determine whether or not metaspheres are suited to the corporate environment, culture and goals. If further investment is warranted, use the experience gained with the consumer-grade tools to assess, acquire and deploy more advanced and capable tools, including advanced headsets, scanners and haptics. If it is determined that immersive experiences and services are not a good fit for the enterprise, at least the consumer-grade equipment will be available for gaming in the break room.

- **Take a minimum viable product approach.** Once a promising use case is identified and ready to be implemented, start small. Do not attempt to create an immersive experience for the entire enterprise. Rather, select a small, well-defined and contained set of capabilities and a small set of initial users. Work with those users to establish requirements for a minimum viable product. Not only will this simplify implementation and deployment, but it will also ease adoption by making the solution easier to understand and operate. As developers or administrators and their users become more familiar and comfortable with the metasphere and working within it, new possibilities will be identified that can be added in subsequent iterations of the product. The same principles apply when acquiring an off-the-shelf solution. Start with the basic offering, preferably a cloud-hosted solution, that requires only basic equipment to utilize. Advanced options can be added as the solution proves its value to the enterprise.

Evidence

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[7] The Impact and Potential of Virtual Reality Training in High-Consequence Industries, Lakewood Media Group (Training magazine).

[8] Accenture Extended Reality (XR), Accenture.

[9] Development and Analysis of Virtual Reality Technician-Training Platform and Methods, Axon Park.

Recommended by the Author

Some documents may not be available as part of your current Gartner subscription.

Maverick* Research: Reflection, Distortion or Deception — the Metaverse's Impact on Corporate and Personal Identity

Maverick* Research: Deepfakes Will Kill the Metaverse; Synthetic Media Could Save It

Web3 and the Metaverse: Incomplete but Complementary Visions of the Future Internet

Table 1: Use Cases and Metasphere Types

Use-Case Category	*Metasphere Type*
Collaboration	Mixed Reality
Training	Virtual Reality/Augmented Reality
Documentation and Support	Augmented Reality
Digital Twinning	Virtual Reality/Mixed Reality

Source: Gartner