THE ENTERPRISE METAVERSE

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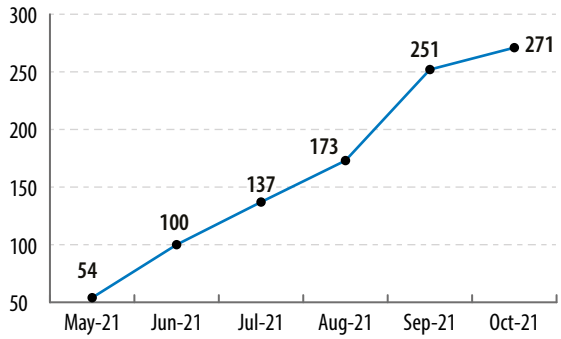
Introduction

From human-to-human to machine-to-machine symbiosis.

The metaverse concept has been recently popularized by Meta but also finds applications across enterprises. We define metaverse as a world where humans are connected to digital twins of themselves (and everything else imaginable), with identities and assets completely run by computer code and transferable across platforms. The metaverse will be underpinned by the cloud continuum, edge products, and other exponential technologies, with a creator economy built around NC/LC and collaborative design and development tools.

This metaverse architecture will make enterprise professionals more productive, innovative, and successful. It will also meet people where they are in the user journey, with experiences that are more perceptive, sentient, and present.

Figure 1. The number of job listings related to the metaverse is growing



Posted jobs: New job postings

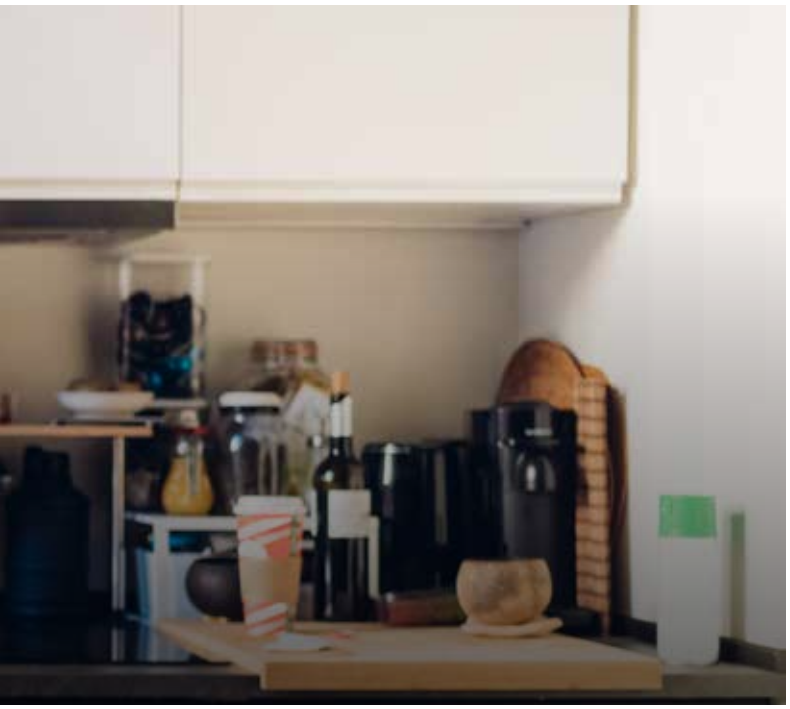
Source: GlobalData

Imagine a manager who wants to offer customers a new product to establish credibility and avoid their churn. But all the related parameters are scattered — the customer relationship management (CRM) data is in Salesforce, logistics data is trapped in an SAP system (managed by another department), and the pricing tool is archaic and poorly managed.

But in the metaverse, the enterprise cloud system knows the manager's name, access level, and the data, systems, and people needed to get the work done. It also knows how the manager and the team like to use data and has a deep understanding of their online behavior, moment to moment. In this example, the system recommends NC/LC tools with strong design elements. These tools can be quickly purchased from a self-service software marketplace, with connectors to the original databases. The manager will thus be able to provide the team with the ability to determine the right product to sell and at the right price point. And all this in days, rather than months.

This new enterprise metafabric will create completely new business and operating models. Firms poised for success will be those that use Agile methodologies widely, flatten organizational structures, and, where necessary, become platforms on which others can build products.

Microsoft is already building its stack of applications for this enterprise metaverse, with a focus on Azure Digital Twins and Microsoft Mesh, a mixed reality environment



for collaborating on projects.[1] Microsoft Project Bonsai is the low code software that can plug into this stack to create intelligent autonomous systems that learn and improve over time. Even consumer majors such as Coca-Cola and Daimler are showing more interest in the enterprise metaverse concept.[2]

> *Digital twins are increasingly adopted in the industry to help improve efficiencies, reduce costs, improve overall safety and realize sustainability goals. The enterprise metaverse can help in creating the next generation of digital twins and their adoption at scale. Overall, the metaverse has immense potential to create new business opportunities for the industry.*
>
> **Ravi Kumar GVV**
> *Engineering Head, Infosys*

Architecting the metaverse

Regardless of platform, we believe the basic building blocks of the metaverse include:

- **Interface:** Mobile, drag-and-drop smart glasses, haptic gestures, neural interface
- **Venue:** Collaborative design, enterprisewide software systems, enterprise applications
- **Exploration:** Ratings, stores, ads, social, software and data marketplaces
- **Creator economy/new experiences:** Design tools, NC/LC, cloud-based AI, asset markets, workflow, commerce, 3D engines, VR/AR/XR
- **Infrastructure:** Cloud, Blockchain, Satellites, GPUs, 5G and 6G, Edge, AI agents, microservices

Creating new metaverse experiences, more around retail, manufacturing, and health care firms, will be possible using 3D engines and XR. Demand for real-time 3D graphics skills is now especially high and increasing 601% faster than the job market overall.[3]

Retail, manufacturing, and health care metaverse experiences will be possible using 3D engines and XR

Collaborative design is also gaining attention, with the likes of Adobe building out a platform on which other metaverse assets will be built. Much of this work happens in the exploration layer, which includes **software and data marketplaces**. The creator economy will flourish across the **cloud continuum**. Blockchain will enable new ways of monetizing value and ensuring verifiable and transparent value chains. Satellites will enable developing economies to connect to the cloud, and 6G connection speeds may be necessary for some of the high-fidelity virtual worlds created by the bigger gaming platforms. In this spirit, we look now at what the metaverse means for design and software development and how the cloud and other layers of the stack will soon enable completely **new business and operating models**.

Sub-theme 1:
Collaborative design

Contains:

- **Stitching together design and engineering**
- **Low-cost products and real-time quality control**

The great reshuffle is occurring. Not only are people talking about when, where, and how they work, but also why they work. According to Ryan Roslansky, CEO of LinkedIn, 70% of people on the platform say they want

flexibility. At the same time, 70% want human connection so that they can collaborate.[4] The enterprise metaverse can contribute here.

Stitching together design and engineering

At its core, the metaverse is just as much about a new way of thinking as it is about the convergence of exponential technologies. And collaborative design is already charting its course in the metaverse. Designers, developers, testers, and business development professionals are using platforms from the likes of Microsoft, Adobe, and Figma to collaborate across organizations on projects of interest. Figma, founded in 2020, is a cloud native user experience (UX)/UI tool that enables real-time collaboration. The company aims to become the backbone for digital world creators. Figma is an open ecosystem, which includes community plug-ins and frictionless sharing among groups. With this plug-in open ecosystem, more designers are creating components that can be reused in different applications. "When a system has this kind of composability, it creates new building blocks, new combinations, and new kinds of creators who can all now communicate visually with each other both within and across organization," says Peter Levine of a16z.[5]

Zeplin is another collaborative design company of note. The platform increases cross-functional collaboration by designing engineering products. In our Agile Radar research, we found that the ability to collaborate across functional boundaries increases a firm's chance of growth by as much as 7% more than competitors.[6]

Nvidia, with its Omniverse platform, has entered the first phase of the enterprise metaverse. With real-time "physically accurate" simulation, clients can use the platform to create, design, and engineer complex workflows of everything from microchips to airplanes: "Omniverse is being tested by 400 companies around the world. It's used at BMW to create a digital factory. It's used by WPP, the world's largest advertising agency. And the Omniverse is used by large simulation architects," says Nvidia CEO, Jensen Huang. "Bentley is using it to create digital twins. It's very important work, and worth looking at."[7]

Firms like Audi are using spatial computing, design thinking, and AR to design their newest models. With all this, people from all over the world can design a car together. Not one piece of the Audi Sky Sphere — a futuristic software platform on wheels — was designed outside of one of these virtual spaces.

Low-cost products and real-time quality control

These sorts of use cases deliver potent benefits for businesses and customers. A lower entry barrier to design and development could see human-centric technology blossom in scale and scope. Low-cost, easy-to-build products become the norm, with more specific measurements and advanced CAD-like software. When the whole team works on projects in real time, quality control is easier. This paradigm will ultimately lead to lower customer churn and lower return rates for defective products. Further, with blockchain-based auditability and transparency, the whole design lifecycle will be more transparent for socially aware millennials.

As Levine from a16z says, the 2020s may just be the decade of collaborative design.[8]

Sub-theme 2:

Cloud continuum

Contains:

- **More cloud as firms go on the offensive, driving profits**
- **Bringing together the IoT, edge, and 5G/6G**
- **The need for zero trust networks**

More cloud as firms go on the offensive, driving profits

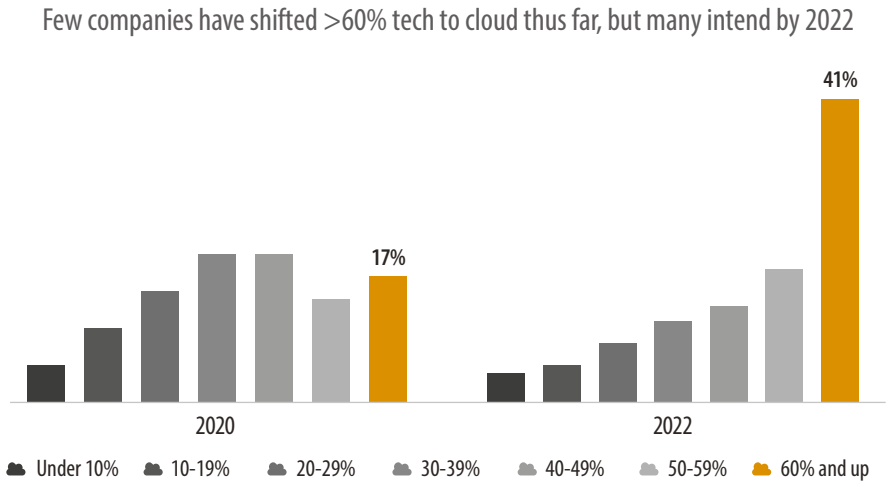
Much of the enterprise metaverse will be built on the cloud, which provides the huge computing power needed. Some applications will work on the edge and across the billions of fog devices, including mobile handsets, sensors, headsets, drones, and factory ware. Hyperscalers such as Google and telcos such as Verizon are already building out this infrastructure and working on applications that will work across the cloud continuum. And the appetite to use their services is growing remarkably, as proved by Cloud Radar 2021 research (see Figure 2).[9]

After a stall in 2020 due to the pandemic, firms are using the cloud to go on the offensive rather than just using the cloud to keep the lights on. Most are looking to accelerate the deployment of AI applications, improve digital capabilities, and achieve scale seamlessly (see Figure 3).

As Satish H.C., EVP of data and analytics at Infosys, says: "AI and data in the cloud enables enterprises to break traditional boundaries and thrive in a collaborative and symbiotic business ecosystem."

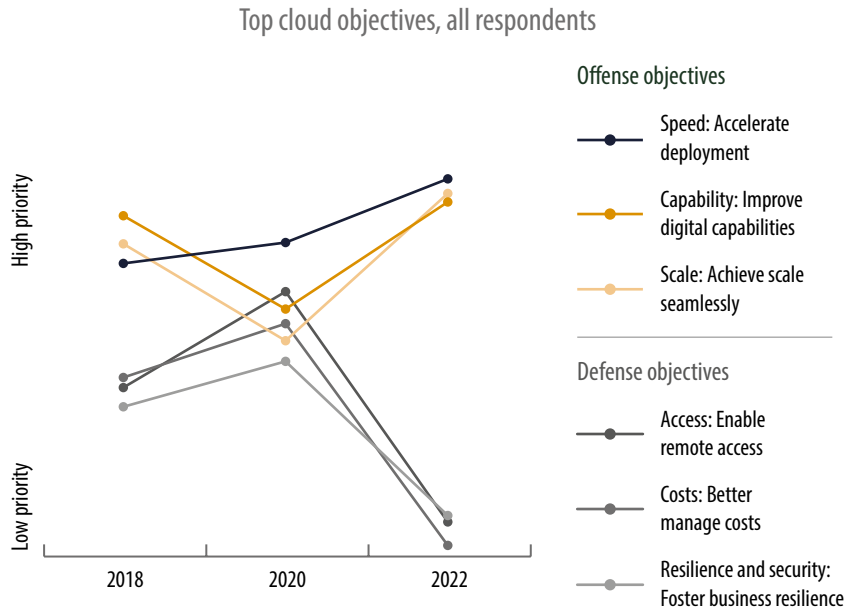
The research found that the cloud is now used to drive revenue, growth, and new business opportunities. Effective cloud usage, according to the report, can deliver $414 billion to annual profits "in the markets surveyed by increasing the development speed and utilizing cloud capabilities to enable a competitive edge."[10]

Figure 2. Companies with high levels of cloud adoption will more than double between 2020 and 2022



Source: Infosys Cloud Radar 2021

Figure 3. Firms are using the cloud to go on the offensive in 2022



Source: Infosys Cloud Radar 2021

Bringing together the IoT, edge, and 5G/6G

This competitive edge includes building data platforms that consolidate and surface enterprise data. With the intelligent cloud and intelligent edge working in harmony, firms will be able to bring together the IoT, digital twins, and mixed reality. For Microsoft, using Azure will enable firms to build "a rich digital model of anything physical or logical — whether it's assets, products, a complex environment spanning people, places, things, and their interactions."[11]

Some processing will be needed on the edge. Systems that link metaverse mobile applications to enterprise supply chain software will require edge computing for enhanced data privacy and security. This means that most of the data stays on the device and reduces latency. Undergirding this sort of activity will be 5G and 6G networks, with alliances formed among hyperscalers, telcos, and other players in the edge ecosystem.[12]

The need for zero trust networks

But a note of caution. As people value this virtual world more, they truly need to safeguard cloud systems from ransomware and malware. Cloud native security will become paramount.

"Firms looking to chart a course in the metaverse must ensure security by design in cloud software systems, platforms, applications, and solutions. Zero trust network access (ZTNA) can further enhance security and improve the human experience for metaverse applications. ZTNA reduces the attack surface, improves connectivity, and doesn't directly expose applications to the internet," says Vishal Salvi, head of cybersecurity at Infosys.

To go a step further, visionary firms can use AI to protect vital infrastructure and stop unwanted intrusions. These threat identification systems can reduce the time any organization in the metaverse spends on detection, response, and remediation.[13]

Sub-theme 3:

Software and data marketplace

Contains:

- **Thriving with software and data**
- **One-picture view of the enterprise estate**
- **Case study: The Infosys Marketplace**

Thriving with software and data

Buyers and sellers of both software and data will expect consumer-grade experiences in the enterprise metaverse. Self-service will be critical. Employees will be encouraged to share new software and data artifacts that they build and deposit them in a shared space for others to use. Employees will then be able to plug together different systems using NC/LC and other connector applications. This sort of trial-and-error discovery and procurement will enable new corporate applications of AI, automation, and other exponential technologies. Taken together, these elements will increase productivity substantially and enable firms to package suites of software and data for human users across the enterprise ecosystem.

One-picture view of the enterprise estate

This sort of marketplace, when looked at through this lens, is like taking a one-picture view of the entire enterprise estate (see Figure 4).

The development of marketplaces in the enterprise metaverse will depend on the ability of firms to openly share data and software across the ecosystem. This will mean that interoperability standards will have to be defined. It also means that techniques such as federated identity management — administering applications that need access to resources in multiple security domains — will have to be used across the enterprise metaverse.

Regardless of which firms actually "own" most of the activity taking place, these marketplaces will enable high-quality assets for creators, designers, and developers to help build and monetize new IP. And asset marketplaces stand to take a central role in how the metaverse develops by 2025 — providing the creator economy with infrastructure to make their products more popular.

Figure 4. The benefits of a software and data marketplace

Simplified view of assets	– Integrated view of data – Accurate, documented, and complete – Enterprise data available, from raw to ready – Smart asset catalog, including operational, technical, and business metadata
Provide actionable assets on demand	– Self-service provision – Data and software requests fulfilled in hours – Creators can find, understand, and prepare datasets themselves – Widespread collaboration and reuse of assets
Enterprise-ready data management	– Marketplace supports new platforms – Provides mature data management capabilities – Provides security, governance, and sensitive data protection

Source: Infosys

Case study

The Infosys Marketplace

The Infosys Marketplace is a repository of artifacts, platforms, solutions, and services for Infosys' business partners and customers. It was built using a product-centric approach, with design thinking and sentient principles embedded into the design. The result is a consumer-grade experience with ratings, reviews, asset discovery, and premium services offered by teams. Along with Infosys IP, such as the DevSecOps platform and Cloud Cobalt Migration platform, 40 platforms and services from the likes of Amazon, Google, IBM, GitHub, Red Hat, and Microsoft have been onboarded. This provides further distribution channels for client IP and improves partnerships over time.

As the marketplace evolves, knowledge sharing and partner and customer co-creation capabilities will be developed. Startups and academia will have access to thousands of Infosys customers and clients. Data artifacts will be consumed in a seamless self-service portal. The UI will adapt in real time to human behavior, using sentient principles such as guided feedback and instant simulation. Feedback, alerts, and recommendations will be provided to users using Infosys Digital Brain — an AI system that understands the complete knowledge graph of the company. The idea is to increase monetization potential for all assets accessed by partners and to provide an increasingly sticky experience. In the future, Infosys Marketplace will be the gateway for sales to understand what solution Infosys has. Here, the whole business ecosystem can see what can be done when professionals work together, reuse assets that worked in practice on big client engagements, and build their own solutions in a completely self-service way.

Network effects will dominate, and the platform will get better. For instance, Amazon's marketplace is a key driver of the behemoth's e-commerce dominance. Today, third-party sellers make up over 60% of Amazon's overall retail sales, compared with 34% in 2010 and 3% in 2000.[14]

Sub-theme 4:

New business and operating models

Contains:

- **A customer-focused Agile operating model**
- **The composable enterprise**
- **The rise of blockchain**
- **The need for diverse talent**
- **Viewpoint: Why Infosys is positioned well for the enterprise metaverse**

The metaverse as imagined by Meta and Microsoft will be worth $800 b by 2024

A customer-focused Agile operating model

This collaborative metaverse ecosystem is about creating more sensual, evocative experiences. And co-creating new experiences and solutions while opening IP to partners and customers will generate great wealth. By one estimation from Bloomberg Intelligence, the metaverse as imagined by Meta and Microsoft will be worth $800 billion by 2024.[15]

As we embed computing in the real-world, and vice versa, completely new ways of working will evolve. Instead of rigid hierarchy and Taylorism, the new operating model will be customer-focused and agile. It will be data driven and software-defined, following a product- and human-centric approach to value delivery. Platforms will emerge as the best way to sell products, and who gets what might just be more evenly distributed. With developers and designers outsourcing coding to citizen scientists, the knowledge economy will become even more interesting. Exponential technologies such as AI and the cloud will continue to rise in importance, as shown by our research on the subject.[16,17] Firms will come together in the metaverse to promote and advertise solutions to customers in a particular market niche and bundle offerings that promote interactions rather than transactions.

The composable enterprise

By 2025, decentralized virtual worlds will underpin many financial markets. IoT will rise in importance. Enterprises will buy or sell more real-time data collected from IoT devices so that they can better understand consumer behavior, improve sales, or build better marketing strategies. Data aggregation services will be huge, combing data marketplaces for upsell opportunities. Business API-as-product — in many ways spearheaded by AWS and Stripe, a financial services company — will come to the fore. With this monetization method, visionary leaders will help their firms unbundle and rebundle their core competencies and create leaner organizational structures that mold around the customer journey.

The rise of blockchain

Spatial computing — the virtualization of activities and interactions between machines, people, objects, and the environment — will become the way people interact with the metaverse. Screens and keyboards will become less important. The most advanced firms will follow in the footsteps of gaming companies like Unity and Unreal, using 3D engines to display geometry and animation. Expect terms like geospatial mapping, gesture recognition, biometric data integration, and next-generation UIs (that support concurrent information streams and analytics) to make their way to the top of technology trends reports. All of this will birth new ways of operating. Employees will use personalized avatars from the likes of Genies, a technology company, to work across various platforms. With virtual identities, asset marketplaces will be used to buy and sell digital goods, with non-fungible tokens (NFTs) growing in prestige. Smart contracts on the blockchain will enable transparent, permissionless, and censorship-resistant commerce. Platforms like Bitcoin, Ethereum, Flow, and Binance Smart Chain will become the foundation for this ownership economy.

The need for diverse talent

Of course, to enable this sort of change requires significant upskilling and cultural change, something our Agile Radar research proves.[18] Team autonomy, design thinking, and product agility are just a few of the buzzwords as this human-centric future unfolds. Digital alone doesn't drive profits, as our research shows. The enterprise metaverse will require the unique perspective of humans. Sourcing diversified talents will be important, with gig work used by big enterprises.

Viewpoint: Why Infosys is positioned well for the enterprise metaverse

It's clear that the metaverse will be built by pulling together a range of technologies, and it will also require many different types of talent, notes Vishwa Rajan, Senior Principal Technology Architect at Infosys. "Designers, artists engineers, and tools, both digital and physical, will be needed in envisioning, creating and scaling an end-to-end solution", he says.

Infosys has already made investments in extended reality and blockchain technologies, and has worked on both internal and external initiatives, building Virtual Living Labs, an immersive world that showcases the next innovations and business models. At the same time, Infosys has already created and delivered immersive experiences that can be turned into metaverse offerings, such as a VR store for the Australian Open, which offered shopping and commerce options and experiences such as virtual try-on.

Infosys also created the Australian Open 360, where fans could watch the live broadcast of matches with friends in an immersive space.

Rajan points to the technologies that will be drawn together, from AR and VR to spatial computing, AI and machine learning, human-computer interaction, cybersecurity, cloud, 5G and Edge. "Infosys has made some strategic investments in these technologies and talent over the past five to 10 years that places it uniquely to help enterprises on their metaverse journey", says Rajan. "Enterprises can count on our depth in business domains and expertise in immersive, interactive and experiential design for defining their use cases, business cases and execution roadmaps."

Theme 3:

Our recommendations

We have identified nine steps that businesses can take for maximum benefit:

Strategic recommendations

- **Create your own metaverse slice:** Leaders should ask the question: "How do we use the enterprise metaverse to make humans more productive and make the right decisions at the right time?" This will guide high-level business strategy and be a roadmap for implementing technologies and ways of working.
- **Invest in blockchain:** Leaders should interrogate blockchain technologies to see if they're appropriate for the business rather than jumping on a bandwagon. Be sure there isn't an established solution before you invest in a novel, unproven or controversial technology
- **Think about the workspace, workforce, and customer:** The metaverse will enable new spaces for customers to engage with businesses and their product. Creating new communicative and collaboration tools for employees and customers is the key. Also important is being empathetic to those that won't be keen to adopt new technology until it is proven.
- **Position a chief security officer as the caretaker of the metaverse:** There will always be security and privacy concerns in the metaverse. Leaders who implement use cases should ensure the chief security and privacy officers are not only aware but in control of developments in this space.
- **Think small, act big:** Building go-to-market and technical capabilities is critical in this paradigm. Leaders should increase their exposure to more business partners. Many firms prioritize five or six strategic partners who influence 70%-80% of their channel revenue. Given its inherent complexity, the metaverse will require a business to broaden its scope, working not only with peers but also innumerable smaller companies. Niche partners could include smart glass manufacturers, tracking technologies, or virtual interfaces.

Tactical recommendations

- **Collect more data for better metaverse models and processes:** Firms should collect as much data as possible on all aspects of their business as they seek to curate their own data marketplaces and sell new metaverse solutions.
- **Enable hybrid cloud and high-performance chips:** The massive amounts of data and networking needed for the metaverse require scalable cloud computing. Along with edge and high-performance graphical processing units, this will enable firms to move seamlessly among metaverse platforms.
- **Hire, hire, hire:** Executives should think about the sorts of metaverse roles they should start hiring for. Prestigious roles include those at the intersection of AR, VR, gaming, blockchain, AI, 5G, and other web3 technologies.
- **Use a systems integrator to do the hard work:** Businesses should work with system integrators to increase their interactive and product-envisioning capabilities, going beyond just mobile apps, next-gen websites, and commerce platforms. Help will also be needed to envision, design, and operate limitless infrastructure platforms, with aptitude in the cloud, edge, 5G, carriers, and blockchain. Further work will need to be done on maximizing monetization models, with breakthrough thinking around potential revenue streams. For example, a bank or a telecom company will want the enterprise metaverse to influence growth and not just become one more channel of customer experience.

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