From the inclusive internet to the inclusive metaverse: the Inclusive Metaverse Index

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About the paper

This paper, written by Economist Impact and supported by Meta, outlines the pilot of a conceptual framework for measuring country-level progress towards a successful metaverse. It will be tested in 20 countries before expanding globally. The report also builds on a previous background paper, *Toward a successful metaverse,* that was published in June 2023.

Economist Impact conducted extensive desk research and an interview programme to develop the framework. We also convened an expert panel to validate and inform it.
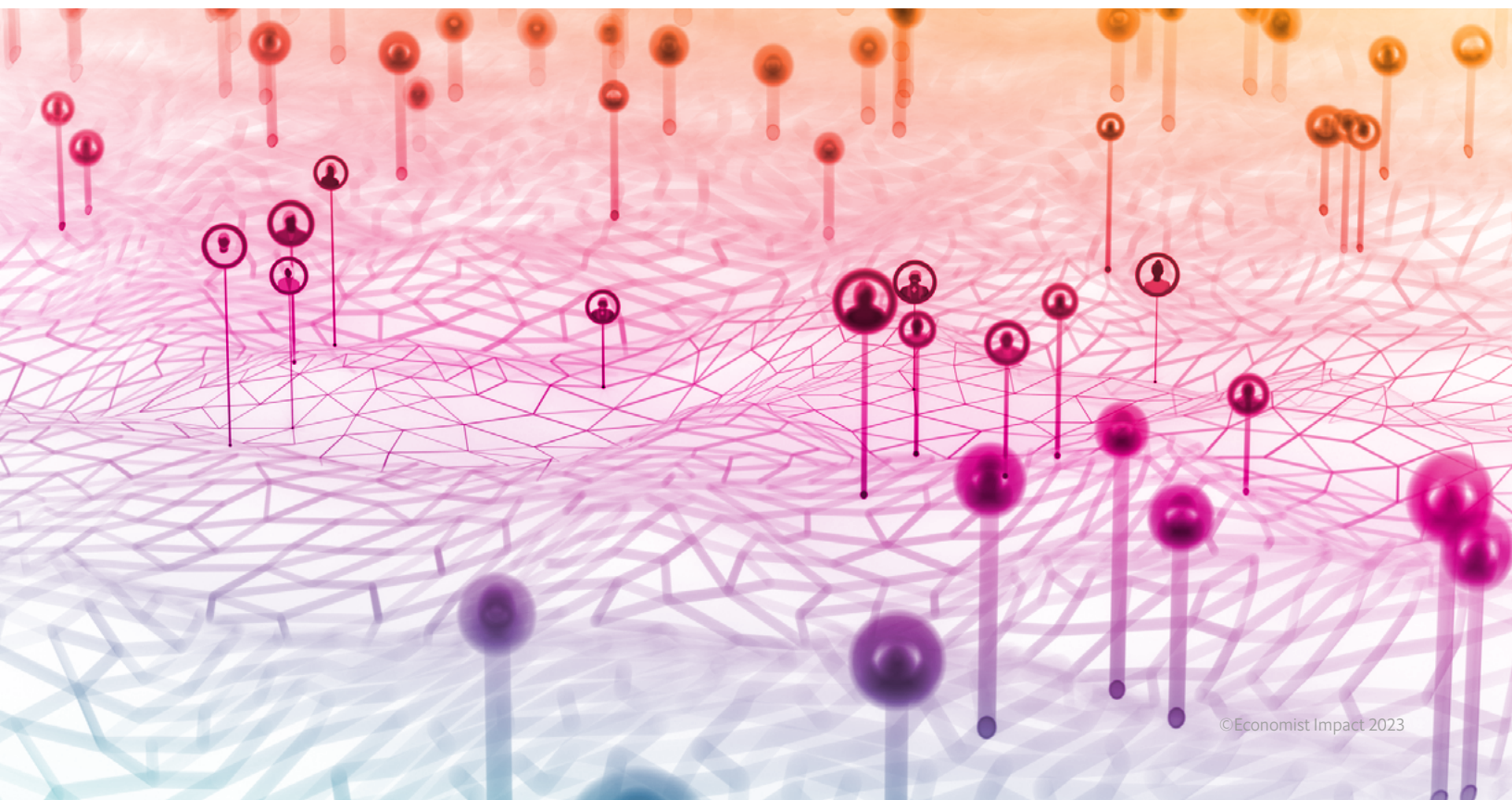
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Executive summary

The Inclusive Metaverse Index

The metaverse is an emerging computing paradigm with the potential to revolutionise the human digital experience. It holds significant promise to advance socio-economic opportunities and foster interconnection. One estimate proposes that the emerging metaverse ecosystem can generate up to US$5trn in value globally by 2030.[1] Even so, we cannot predict how it will unfold over the coming decades or whether the associated benefits will materialise in an equitable manner. Many possible pathways remain open. Its full potential social and economic benefits can only be realised if barriers are overcome, such as the affordability and performance of technologies and the establishment of acceptance and trust. For some, barriers are more fundamental, as despite much progress more than 2.6 billion individuals remained unconnected to the internet in 2023.

To assist in guiding the way forwards and unlocking the value of the metaverse, **the Inclusive Metaverse Index provides key stakeholders with a cross-country benchmarking tool that illuminates what is required to develop a successful metaverse and bolster digital competitiveness for tomorrow.**

A standardised approach for measuring countries' progress towards metaverse adoption is needed to support key stakeholders in developing a metaverse ecosystem and overcoming barriers. **Economist Impact broadly defines a successful metaverse ecosystem as one where the expected social and economic benefits of the metaverse are realised while the associated risks are mitigated.**

To achieve these outcomes, metaverse-related technologies and content must be available on a cost-effective basis, supported by suitable digital infrastructure and talent. Governments should devise inclusive policies that promote affordable access to the internet and hardware for marginalised populations while supporting digital literacy and promoting privacy, safety and cybersecurity. Local demand by industry and consumers is also required, which remains contingent on how fast existing use-cases become mainstream and how effectively immersive experiences generate economic value. An ecosystem inclusive of all stakeholders is necessary to promote responsible contextual development and localisation that cultivates a virtuous cycle of affordable access to and development of immersive technologies and the emerging metaverse.

A country that is performing well on this set of indicators will have the right foundation to take advantage of the emergence of the metaverse ecosystem while contributing to its development. Still, every country will exhibit a different pathway to metaverse maturity depending on its sectoral mix, level of development and national priorities. As such, each may also provide unique contributions to the global ecosystem. With these factors in mind, the index framework is designed to serve as a diagnostic tool that assesses the unique trajectory of each country, starting from the essential building blocks for a metaverse ecosystem.

Our framework is grounded in the current understanding of the metaverse, which will continue to evolve. It is our aim that as this index develops in the future, it supports countries in developing inclusive metaverse ecosystems as well as the emergence of a successful and inclusive global metaverse.

Index structure

The index is broken into two pillars, Access and Engagement, which each contain two categories.

Access

Refers to the fundamental *availability* of underlying and key technologies and their *affordability*.

Availability

The existence and maturity of physical and digital infrastructure required for a metaverse ecosystem to develop in a country.

Affordability

The costs incurred by consumers, firms and governments to access immersive technologies.

Engagement

comprises the *relevance* of the emerging metaverse ecosystem for current and potential users, as well as the *readiness* of countries to engage with it in a safe and secure manner.

Relevance

Awareness of the metaverse, and the extent to which the emerging metaverse ecosystem has current and potential value to individuals and organisations within a country, which is important to stimulate interest and adoption.[2]

Readiness

The ability of individuals and organisations to engage with and contribute to the emerging metaverse ecosystem in a safe and responsible manner.

Introduction

The metaverse holds significant promise to advance socio-economic opportunities and foster interconnection. A leading forecast suggests that the emerging metaverse ecosystem could generate up to US$5trn in value globally by 2030.[3]

Immersive technologies and experiences, building blocks of the metaverse, already span a range of industries, including learning and education; work and collaboration; digital twins, which are real-time, virtual representations of objects or systems; social interaction and entertainment; and healthcare. In the latter instance, these technologies are being used for training healthcare professionals, medical education, surgeries,[4] as well as providing mental health support and services.[5,6] Despite such emerging use-cases, applications could take years to gain widespread adoption. Many are yet to be identified, and are dependent on how the metaverse develops.

The program will be a pilot conceptual framework for measuring country-level progress toward a successful metaverse.

DEFINING THE METAVERSE

The metaverse is a collective term for a vast interoperable network of immersive technologies. While there is currently no universally accepted definition, many overlap. More than 160 companies are currently working on creating their own of these worlds.[7] Still, much about its development remains up in the air. For instance, there are differing visions around who should own the data and uncertainty surrounding the trajectory of the ecosystem's development, given the lack of a consistent definition. Regardless, while immersive technologies and the building blocks of the metaverse are developing rapidly, the metaverse itself is not yet here.

The metaverse would consist of a variety of interoperable applications and digital environments accessible via computers and new technologies such as augmented reality, virtual reality and mixed reality. When looking at its etymology, the word 'metaverse' combines the Greek word for "beyond" with the latter syllable of "universe", which signals limitless possibilities.

The metaverse is a contested term; no single conceptualisation captures the differing—and often-competing—perspectives of all ecosystem participants. There are several parallel initiatives to create a metaverse, which are still in their infancy, leaving considerable space for research and debate. Some definitions of the metaverse posit it as the internet's next evolutionary step. "In simplest terms, the metaverse is the internet, but in 3D,"[8] argues Ed Greig, chief disruptor at Deloitte. Others view it as a distinct phenomenon. For example, Jerry Michalski, a senior industry fellow at the Royal Melbourne Institute of Technology, observes that the metaverse experience will be more similar to a 3D TV than the web.[9] Emphasising the multitude of conceptions of the metaverse and commenting on how this breadth offers value to those seeking to pin it down, Eli Noam, director of the Columbia Institute for Tele-Information, remarks, "to *an extent, the strengths of the metaverse lie in the eyes of the beholder and in their ability to imagine how the real and the virtual worlds might bond.*"[10]

Still, many definitions do overlap to some extent, putting forward the ideas of an "immersive" experience, interoperability, digital avatars and a persistent "always on" virtual world, for example. Underlining the immersive potential of the metaverse, Kay Vasey, chief connecting officer at MeshMinds notes, *"Art can make the world 'felt'. If you could use technology to step inside a piece of art, wouldn't it make the experience so much more engaging? That's the promise of the metaverse–it can enable us to navigate the web in a 3D world, making it so much more 'felt'.*[11]

The current value of immersive technologies and potential social and economic benefits of the metaverse are apparent, but can only be fully realised if a number of market, organisational and consumer barriers are resolved, such as the affordability and performance of technologies, and the establishment of acceptance and trust. For instance, a 2022 consumer survey in the US and the UK found that privacy concerns and the monetisation of personal information are the second- and third-biggest barriers to metaverse adoption, coming behind a fear of isolation.[12] In parallel, some of the key technical challenges include developing a seamless user experience and the relatively slow and costly progress of metaverse technology.[13] Metaverse progress depends on the entire technology ecosystem, such as infrastructure, bandwidth, graphics engines, haptics, form factor and processing power, as well as user-level adoption of headsets, hand detection and eye-tracking systems.[14,15] Progress is also constrained by limited funding for hardware start-ups. Given the need to develop these and other technologies and bring them to market, experts estimate that the metaverse will become mainstream only in the next 10 to 15 years.[16,17]

Index objective

A standardised approach for measuring countries' progress towards immersive technology adoption is needed to support key stakeholders in developing a metaverse ecosystem and overcoming barriers, in order to unlock the value of the metaverse. Governments and companies around the world have launched metaverse initiatives,[18] yet there is no single approach for measuring readiness that enables countries to track progress and drive competitiveness in an increasingly digital world.

Since 2017, Economist Impact, sponsored by Meta, has produced the Inclusive Internet Index (3i) annually.[19] The 3i served as a benchmark to measure, track and compare country-level progress towards creating an accessible, affordable and relevant internet. By assessing the state of internet adoption across the world, this tool shapes critical policy considerations. In

its 2022 iteration, the 3i assessed 100 countries and covered 99% of the world's population.[20]

Following six editions of the 3i, much progress has been made on internet accessibility and inclusion. As a result, we are pivoting away from the index and moving forward with a new research question that aims to support countries to track and compare metaverse foundations: **what are the enabling factors that countries should prioritise to build a successful metaverse ecosystem?**

Economist Impact broadly defines a successful metaverse ecosystem as one where the expected social and economic benefits of the metaverse are realised while associated risks are mitigated. These benefits accrue to users, through their participation in global, regional or local ecosystems as they develop. They will also flow to the many stakeholders who play a role in contributing to ecosystem development through hardware and platform development, entrepreneurial activities and content creation.

To achieve these outcomes, metaverse-related technologies and content must be available on a cost-effective basis, supported by suitable

What are the enabling factors that countries should prioritise to build a successful metaverse ecosystem?

digital infrastructure and talent. Therefore, internet inclusion remains an important aspect of this new forward-looking index: more than 2.6 billion individuals remained unconnected to the internet in 2023.[21] Indeed, metaverse access risks widening digital divides both within and between countries. This divide also extends to gender. As of 2022, 259 million more men than women are using the internet.[22] Governments should devise inclusive policies that promote affordable access to the internet and hardware for marginalised populations, while supporting digital literacy and promoting privacy, safety and cybersecurity. Local demand by industry and consumers is also required. An ecosystem inclusive of all stakeholders is necessary to promote responsible contextual development and localisation that cultivates a virtuous cycle of affordable access to and development of immersive technologies and the emerging metaverse. The ultimate objective is for all organisations and individuals to experience a seamless, safe and rich metaverse that enhances socio-economic opportunities.

Accordingly, the Inclusive Metaverse Index provides key stakeholders—including policymakers, regulators, technologists, developers, investors, academic institutions and think-tanks—with a rigorously-developed diagnostic tool. It aims to both map the current landscape of country-level sophistication in

building metaverse foundations and support stakeholders in identifying and addressing gaps in the ecosystem. A country that is performing well on this set of indicators is one that has the foundations in place to simultaneously take advantage of the emergence of the metaverse ecosystem while contributing to its development.

The index also facilitates comparisons and identifies good practices from which countries can benchmark themselves across a range of relevant metrics to assess their gaps. This can offer a roadmap and comparative advantage. Still, the conceptual index framework will need to evolve as the global metaverse ecosystem continues to develop in the future.

Trajectories towards a successful metaverse

Every country will exhibit a different pathway to metaverse maturity, and may provide unique contributions to the global ecosystem. The index framework can serve as a diagnostic tool that assesses the unique trajectory of each country, starting from the essential set of building blocks for a metaverse ecosystem. "When working with a group of countries across the income spectrum, we need to take the lowest common denominator while thinking about developing metaverse capabilities, as advanced economies are likely to have better baseline technological capabilities than countries at the

The Inclusive Metaverse Index provides key stakeholders with a rigorously-developed diagnostic tool that can map the current landscape of country-level sophistication in building metaverse foundations, and support them in identifying and addressing gaps in the ecosystem.

lower end of the development spectrum,"[23] explains Samuel Ng, former digital innovation and scaling lead at the UNDP Chief Digital Office.

For example, the Democratic Republic of the Congo is home to over 99 million people, but only 21% of the population has access to electricity.[24] When considering the inclusive expansion of the metaverse ecosystem within such a context, broadening access to electricity becomes a necessary focus.

In contrast, China, the US and the EU currently appear most likely to lead the development of international platforms because of innovative technology ecosystems and sizable investments in research and development. In China, metaverse technologies are generally viewed favourably and there is burgeoning domestic hardware and content development.[25] According to a 2022 IPSOS survey, 78% of respondents in China mentioned that they have positive feelings about engaging with extended reality in daily life.[26] Optimism around engaging with extended reality is generally reflected elsewhere, particularly in India, Saudi Arabia and Latin American countries such as Peru, Colombia and Mexico.

China's next steps involve improving affordable access to high-quality hardware while expanding the range of content and tools. In the US, Silicon Valley and its big tech companies are working to develop large-scale immersive technology platforms. In the EU, if history is any guide, member states will likely develop governance structures that eventually serve as a guiding standard for other countries. In addition, the European Commission has adopted a new strategy on Web 4.0 and virtual worlds.[27]

"When working with a group of countries across the income spectrum, we need to take the lowest common denominator while thinking about developing metaverse capabilities, as advanced economies are likely to have better baseline technological capabilities than countries at the lower end of the development spectrum."

Samuel Ng, Digital Innovation and Scaling Lead, UNDP Chief Digital Office.

What are we measuring?

The index is composed of two pillars: **Access** and **Engagement**, each containing two categories. **Access** refers to the fundamental *availability* of digital infrastructure, fast and reliable internet and user hardware, all representing prerequisites for accessing the metaverse, as well as their *affordability* to end users. **Engagement** comprises the *readiness* of individuals and organisations to engage with the emerging metaverse ecosystem and do so in a safe and secure manner, as well as the *relevance* for users, as measured by awareness of the metaverse and the extent to which the emerging metaverse ecosystem has current and potential value.

Access and engagement work together (see Figure 1). Access is needed for engagement. Engagement can in turn promote access, particularly through market-driven infrastructure developments, price decreases, and improved consumer and industrial hardware. This can then contribute to further engagement, leading to a virtuous cycle.

Countries' assessments using the index will rely on a variety of metrics, in light of their differing needs when it comes to advancing the metaverse ecosystem. The goal is not to compare countries but rather to evaluate their readiness for adoption and identify good practices.

All four categories—*availability, affordability, readiness* and *relevance*—must emerge together to enable a metaverse ecosystem. Baseline availability must come first, as it is a precursor to affordability and relevance: one cannot have an "affordable" or "relevant" metaverse without having a metaverse at all.

Figure 1: Access and Engagement create a virtuous cycle for ecosystem development
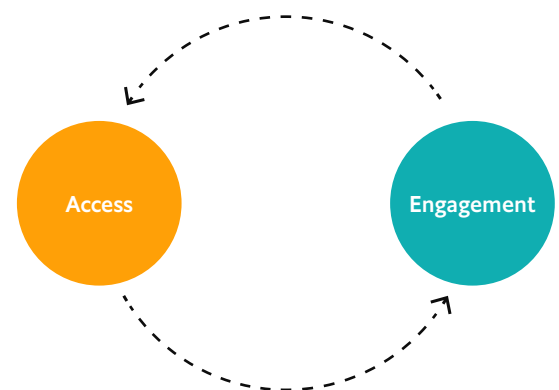
Once the initial availability is there, relevance, affordability and availability work together to drive the size and sophistication of the responsible and inclusive metaverse ecosystem in a country. Relevant content will encourage use and incentivise availability and competitive pricing. Competitive pricing will increase availability and create additional incentives for developing relevant content. Availability is likely to lower the price and increase demand for relevant content.

Readiness impacts the ecosystem as a whole: if the populace has a high level of digital literacy and skills and the country has a sophisticated environment of trust, safety and cyber readiness, the ecosystem can grow and develop unconstrained. If, instead, readiness is low, it will curtail the growth of the entire metaverse ecosystem or limit positive economic or social outcomes.

Access

Access is a precursor to a metaverse, as availability and affordability are fundamental components to both building and participating in its development and progress.

Availability

This category measures the existence and maturity of the physical and digital infrastructure required for a metaverse ecosystem to develop in any given country.

One such element is basic access to electricity. Over 91% of the world's population now has access to electricity, according to the World Bank.[28] However, 760 million individuals were still lacking access in 2022, mostly (80%) in sub-Saharan Africa.[29] Closing the gap between countries is important for the inclusive global development of the metaverse ecosystem.

Fast and reliable internet access is also needed for a meaningful user experience, whether via extended reality (XR) devices—an umbrella term for any technology that alters reality by adding digital elements to the physical or real-world environment to any extent, such as

augmented reality (AR), virtual reality (VR) and mixed reality (MR)— or in non-immersive 2D environments. Interventions to expand internet access to underserved communities are key, particularly since 4G mobile connectivity is considered to be the minimum threshold for a meaningful internet experience, according to the Alliance for Affordable Internet (A4AI). Yet so many globally still lack any internet access.

Additional digital infrastructure, such as access to cloud computing services and data centres, are critical to support low latency, high bandwidth, secure connections, and ensure that a metaverse can be adopted by a large portion of the population. For example, the European Commission Next Generation Internet initiative aims to "reimagine and re-engineer the internet of tomorrow",[30] with the goal of establishing foundational technology building blocks that embody European values, such as inclusiveness and data protection. The objective is to empower users and bring gigabit internet connectivity to all citizens and businesses across member states by 2030.[31]

"The reorganisation of the infrastructure to support scaling of the metaverse will entail engineering, organisational, and financial challenges."
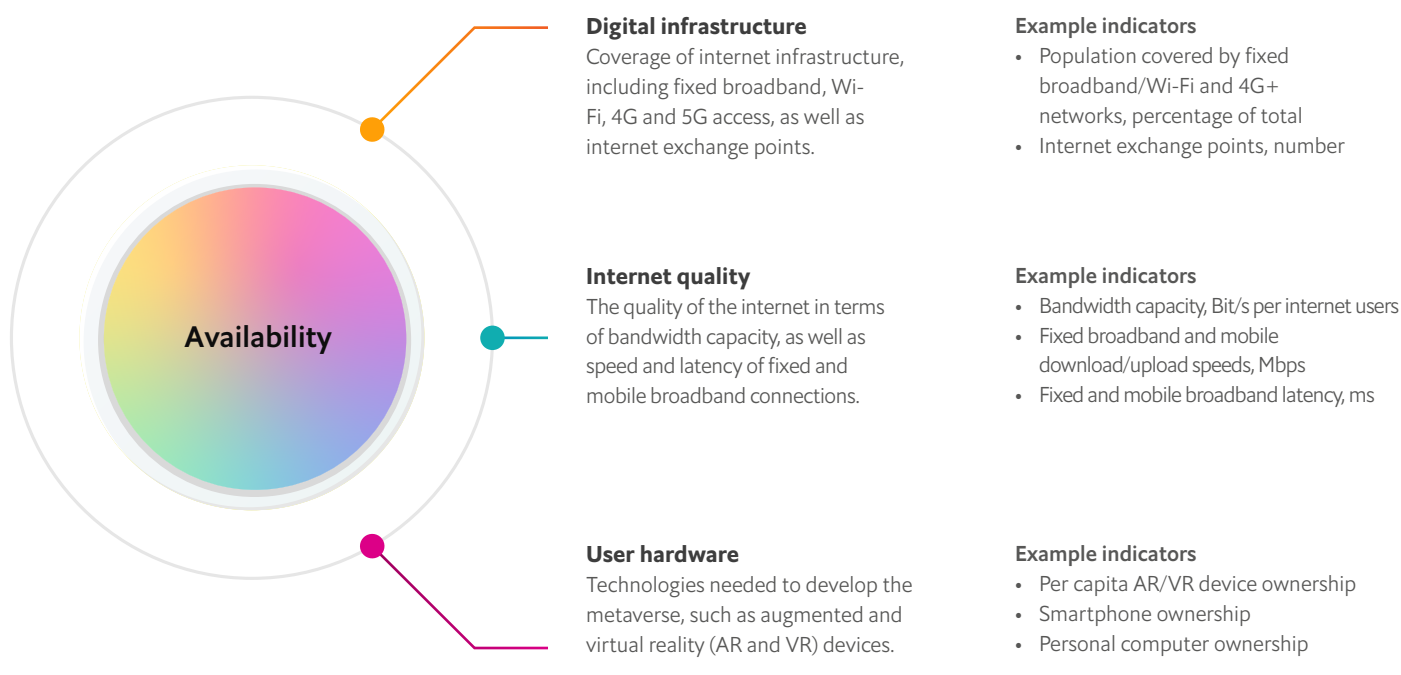
Eli Noam, Director of the Columbia Institute for Tele-Information

"The reorganisation of the infrastructure to support scaling and speedup of the metaverse will entail engineering, regulatory, organisational, and financial challenges" for telecommunication and technology corporations, says Eli Noam, director of the Columbia Institute for Tele-Information.[32] Although most users are likely to access the emerging metaverse through 2D devices in the near future—meaning existing and developing technologies are likely to suffice—a more forward-looking and immersive vision would require significantly more computing power: it is estimated that a thousand-fold increase in computation beyond what state-of-the-art semiconductor chips can deliver as of 2023 might be required.[33]

Other key technologies are needed to support metaverse development. For example, artificial Intelligence (AI) can process vast amounts of data to better understand user habits and preferences, thus enabling a more personalised experience. Generative AI can streamline content development and help produce realistic and interactive virtual worlds, contributing to the feeling of "presence" in a metaverse. In addition, VR or AR devices are important tools to access immersive content. As hardware devices become more sophisticated they should also become more wearable as their size decreases, likely with or without screens, according to Cathy Hackl, the chief futurist and co-founder at Journey, a global design and innovation studio.[34]

Figure 2. Sub-components of the Availability category

Digital infrastructure
Coverage of internet infrastructure, including fixed broadband, Wi-Fi, 4G and 5G access, as well as internet exchange points.

Example indicators
- Population covered by fixed broadband/Wi-Fi and 4G+ networks, percentage of total
- Internet exchange points, number

Internet quality
The quality of the internet in terms of bandwidth capacity, as well as speed and latency of fixed and mobile broadband connections.

Example indicators
- Bandwidth capacity, Bit/s per internet users
- Fixed broadband and mobile download/upload speeds, Mbps
- Fixed and mobile broadband latency, ms

User hardware
Technologies needed to develop the metaverse, such as augmented and virtual reality (AR and VR) devices.

Example indicators
- Per capita AR/VR device ownership
- Smartphone ownership
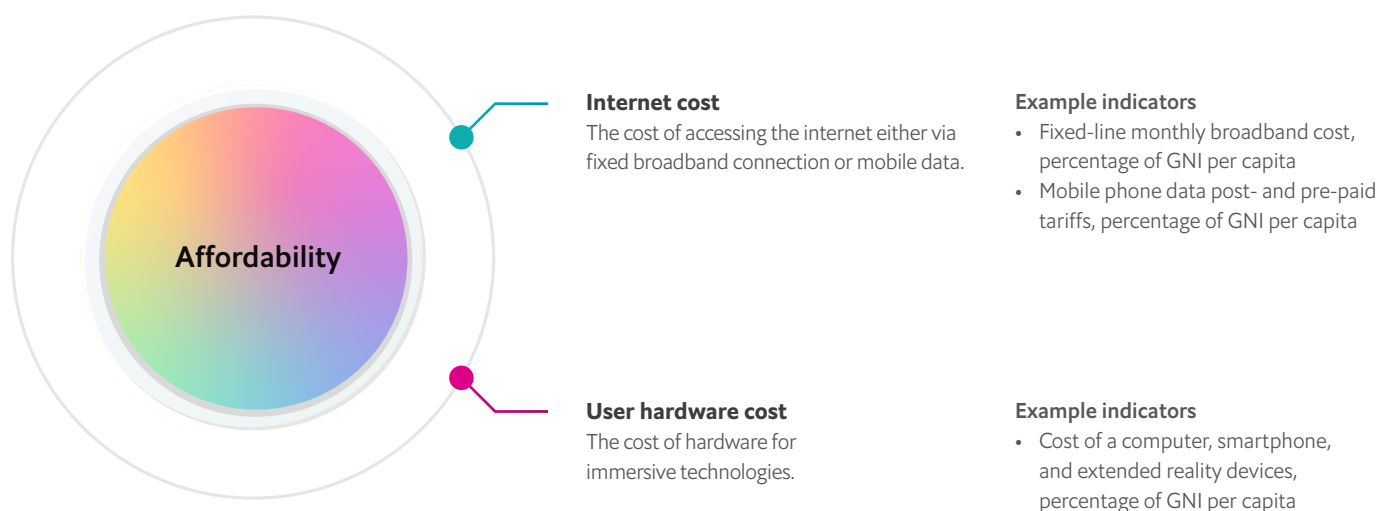- Personal computer ownership

Affordability

This category measures the costs incurred by consumers, firms and governments to access the metaverse ecosystem.

The metaverse ecosystem will be inaccessible if internet access remains unaffordable. The Broadband Commission, established by the ITU and UNESCO, has set the target that countries should offer fixed or mobile broadband for less than 2% of monthly Gross National Income (GNI) per capita by 2025.[35] Similarly, the A4AI, a non-profit, encourages countries to offer 5GB of broadband for less than 2% of the average monthly income by 2026.[36] Despite these targets, a fixed broadband subscription averages over 30% of GNI per capita in low-income countries, compared with just over 1% in high-income ones.[37] It is imperative to address the challenge of cost in order to level the playing field for everyone to participate in and contribute to the metaverse ecosystem.

In addition, as the metaverse is being designed for a variety of devices, including smartphones, VR headsets and AR glasses, one challenge for designers is to ensure a consistent and seamless experience.[38] Metaverse inclusion will be unequal if only some devices perform well but remain unaffordable.[39] The price of consumer VR headsets in the US, for example, ranges from under US$100 for an entry-level option to more than US$3,000 for a high-end device.[40] Globally, the cost of sophisticated equipment can create a digital divide for metaverse building blocks. For reference, the annual income per person in the least developed countries was US$1,259 in 2022, which renders high-end devices out of reach to the average earner living in these countries.[41]

Figure 3. Sub-components of the Affordability category

Affordability

Internet cost
The cost of accessing the internet either via fixed broadband connection or mobile data.

Example indicators
- Fixed-line monthly broadband cost, percentage of GNI per capita
- Mobile phone data post- and pre-paid tariffs, percentage of GNI per capita

User hardware cost
The cost of hardware for immersive technologies.

Example indicators
- Cost of a computer, smartphone, and extended reality devices, percentage of GNI per capita

Engagement

Engagement requires digital literacy and specific in-country technical skills, coupled with cybersecurity measures. Low readiness can limit social and economic benefits, preventing metaverse ecosystem growth. Relevance encourages usage, incentivises availability and promotes competitive pricing, providing a virtuous cycle with the Access pillar.

Relevance

This category explores the extent to which individuals are aware of the metaverse, and how much the emerging metaverse ecosystem holds current and potential value for individuals and organisations within a country, which is critical for stimulating interest and adoption.[42]

Users have to first become aware of it. Once that happens, they need to see the value of immersive technologies and the emerging metaverse for meeting their daily economic and social needs.

While many use-cases could take years to enter the mainstream or even be identified, existing ones illustrate the potential of the metaverse and possible high-value applications. Evidence also suggests that companies are already looking for ways to take advantage of immersive technologies and other metaverse building blocks. As one example, PwC found that close to 70% of surveyed executives in India plan to integrate them into their organisational activities.[43] A review of existing literature reveals five high-potential, near-term immersive technology applications: learning and education; work and collaboration; digital twins; entertainment; and healthcare. These are likely to be uses that drive value and stimulate adoption, as users see the benefits of participating or take part naturally through their jobs or in their interactions with educators, healthcare providers and the government.

For example, emerging metaverse technologies offer immersive learning opportunities in which students can explore virtual environments and engage with others through computers and XR.[44,45] Additionally, immersive work platforms are set to support the labour market's transition towards remote or hybrid working while enhancing feelings of social connection and collaboration, facilitating activities like onboarding and training.[46] According to a 2022 survey conducted by Censuswide, 90% of business professionals in Brazil, Columbia and Mexico would rather participate in meetings using immersive technologies compared with existing video conference tools.[47] Digital twins, which can be created within a metaverse
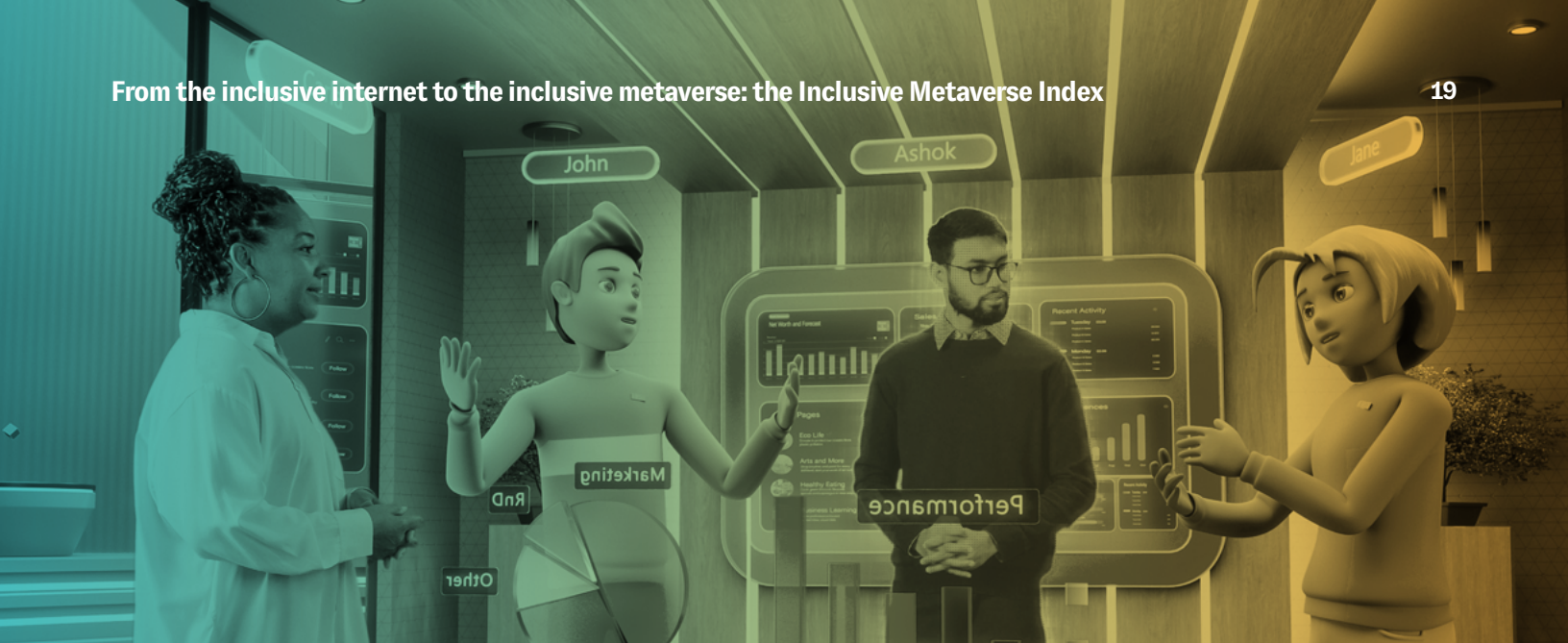
ecosystem, can drive greater efficiency, safety and productivity.[48] German auto manufacturer BMW has already created a digital twin of its production lines, expanding the possibilities of monitoring and improvement.[49]

The value proposition of the metaverse in a country will be dictated not just by relevant uses, but also by users' perception of the usefulness and ease of use of the metaverse.

Once users become aware of it and understand its value proposition, they are likely to be drawn to the metaverse due to network effects.

The higher the number of users, the stronger the desire to join the metaverse, the better the applications, and thus the value it creates grows. And this does not hold true just for metaverse platforms, but also for the potential advertisers or sellers who could connect with customers there.

Figure 4. Sub-components of the Relevance category

Awareness
The level of awareness towards the metaverse among the general population.

Example indicators
- Familiarity with the metaverse, percentage of population

Relevance

Value proposition
The potential for metaverse content and services to stimulate beneficial economic or social outcomes.

Example indicators
- Interest in utilising immersive technologies over the coming 12 months, percentage of population
- Benefits of immersive technologies for carrying out tasks
- Market fit of existing sector-specific immersive technologies

Usage
The extent of engagement with immersive technologies and the quality of the experience.

Example indicators
- Rate of usage of immersive technologies during the last 12 months, percentage of population
- Quality of experience among immersive technology users

Readiness

This category measures the ability of individuals and organisations to engage with and contribute to the emerging metaverse ecosystem in a safe and responsible manner.

Core to readiness is trust, safety and cybersecurity considerations, both for individual users and organisations. For example, the global average cost of a data breach in 2023 was US$4.45m, a 15% increase over three years, according to a report by IBM.[50] The metaverse, as with other new internet technologies, will be a prime target for malicious actors. Metaverse applications and devices could collect and store a wider range of sensitive and personal data, such as people's hand and eye movements, as well as facial features. Attackers have the ability to eavesdrop on users, social engineer harassment attacks, or collect personal data on users' positions, orientations and physical surroundings.[51,52] While these are not strictly new forms of cyber threats, combating them within novel digital environments and at increased scale is likely to require updated cyber-prevention and education efforts.

Existing forms of online harm, already extraordinary prevalent for women and children,[53] could be intensified by the sensory-rich metaverse environment. According to a

2019-20 survey developed by The Economist Intelligence Unit that measures the prevalence of online violence against women in 51 countries, an alarming 85% of women respondents reported witnessing online violence against other women (including those outside of their networks). A 2021 survey from The Economist Intelligence Unit found that 54% of global young adults were victims of some form of online sexual harm as children. Still, the emergence of the metaverse also represents an opportunity to improve upon the current shortcomings of the internet.

It is therefore vital to take a proactive rather than reactive approach to developing trust and safety, according to Victoria Baines, senior research associate of the Intellectual Forum at Jesus College, University of Cambridge. "There is an opportunity to incorporate lessons learnt for the development of the metaverse, a valuable approach not considered for web 1.0 and web 2.0." In addition, she added, "without trust and safety, the metaverse will not be ready."
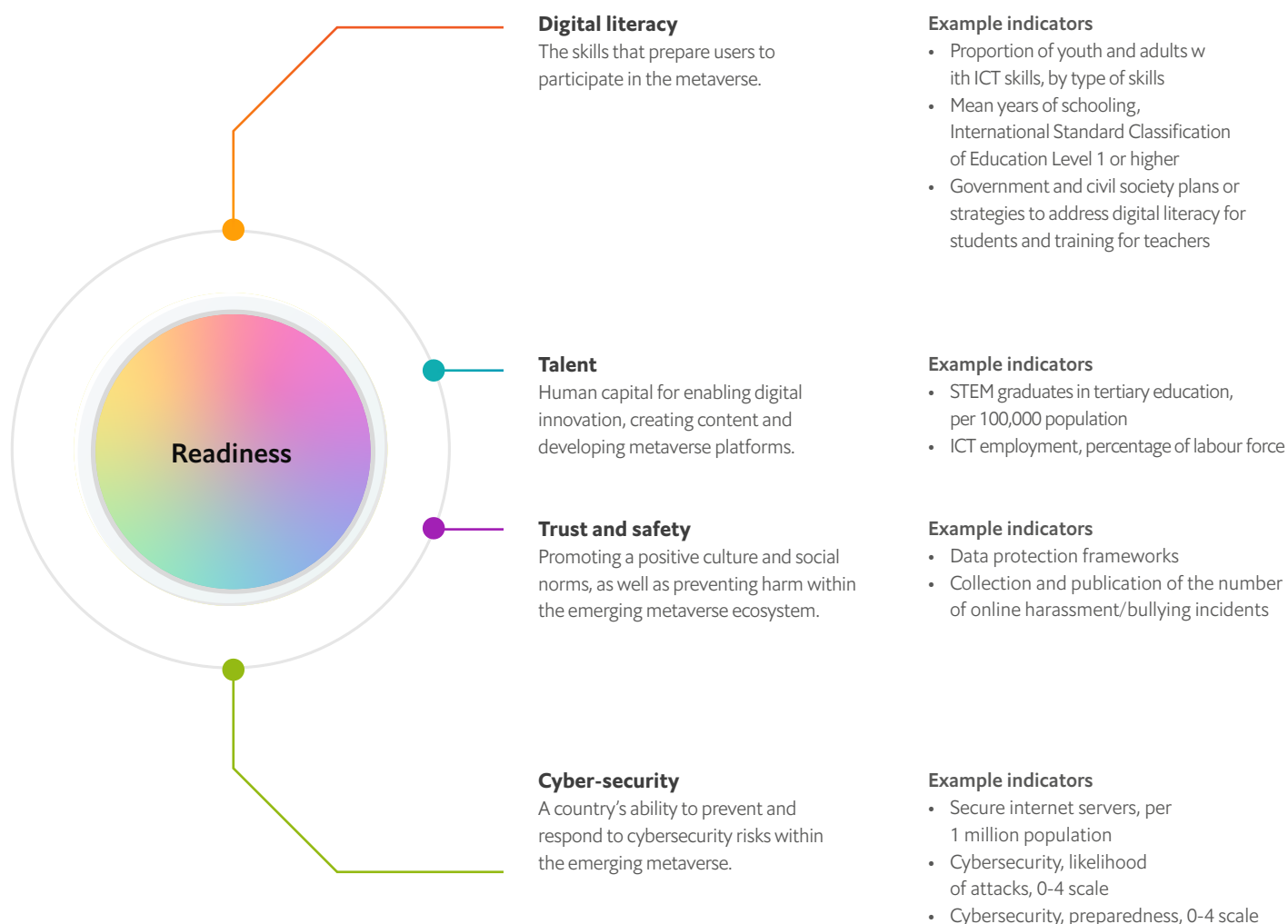
Metaverse users need to be sure that governments, technology companies and creators will implement policies and other measures protecting their privacy and data while ensuring their safety and security. At a country level, the vulnerability of cyber attacks, along with the ability to prevent and respond to those threats within the metaverse are equally important.

Countries should foster talent that enables the creation of virtual platforms and relevant applications. Metaverse content production involves collaboration between digital storytellers, 3D creators, modeller animators and software engineers, among others. Together, they create content, make sure it is compatible with the platform and devices, and distribute it to users. Additionally, countries might need to address potential talent shortages in jobs relevant to the metaverse, and ensure that talent is developed in an inclusive way.

Digital literacy consists of a wide range of abilities—including cognitive, physical, sociological and emotional—that individuals require in order to participate in digital spaces, including the metaverse. For example, digital literacy translates into knowledge of how to run software or operate digital devices, the ability to create new content, evaluate the quality and validity of information, or understand the rules and norms of cyberspaces.[54] Without digital and metaverse literacy, it will be difficult for users to engage, even if the ecosystem is available and there is a compelling value proposition.[55]

Figure 6. Sub-components of the Readiness category

Digital literacy
The skills that prepare users to participate in the metaverse.

Example indicators
- Proportion of youth and adults w ith ICT skills, by type of skills
- Mean years of schooling, International Standard Classification of Education Level 1 or higher
- Government and civil society plans or strategies to address digital literacy for students and training for teachers

Talent
Human capital for enabling digital innovation, creating content and developing metaverse platforms.

Example indicators
- STEM graduates in tertiary education, per 100,000 population
- ICT employment, percentage of labour force

Trust and safety
Promoting a positive culture and social norms, as well as preventing harm within the emerging metaverse ecosystem.

Example indicators
- Data protection frameworks
- Collection and publication of the number of online harassment/bullying incidents

Cyber-security
A country's ability to prevent and respond to cybersecurity risks within the emerging metaverse.

Example indicators
- Secure internet servers, per 1 million population
- Cybersecurity, likelihood of attacks, 0-4 scale
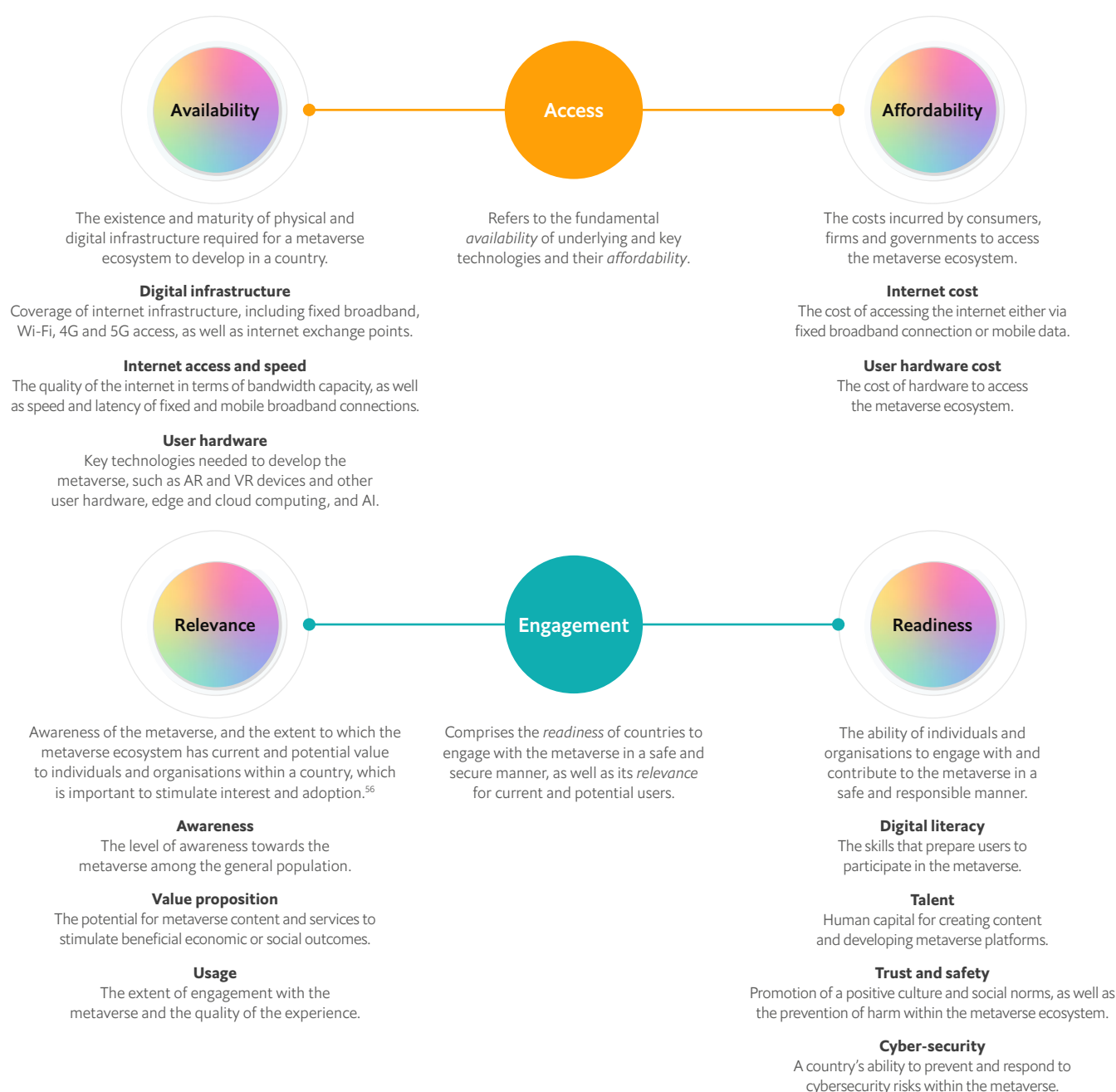- Cybersecurity, preparedness, 0-4 scale

Conclusion

The metaverse is an emerging computing paradigm with the potential to revolutionise the human digital experience, providing entry points to a virtual world shared by millions of users. It could fundamentally change how we interact with each other, offer business opportunities and provide new types of public services by governments. Yet, although the social and economic potential of the metaverse is undeniable, the future remains uncertain.

We cannot predict how the metaverse will unfold over the coming decades, or whether the associated benefits will materialise in an equitable manner. Business cases that will seem obvious in hindsight tomorrow are unfathomable today. Many potential pathways remain open: it is possible, for instance, that the interoperable, future-of-the-internet metaverse never emerges, and we instead see multiple competing virtual worlds or disparate, sector-specific uses rather than a true "metaverse".

The Inclusive Metaverse Index will track progress on building a successful metaverse ecosystem through the four categories of *availability*, *affordability*, *relevance* and *readiness*, accounting for enabling factors such as internet access, digital literacy and interest in the metaverse. It also considers challenges such as cybersecurity, privacy and limits towards adoption. Through greater **access and engagement**, the metaverse can fulfil its promise to deliver social and economic gains. Beyond its diagnostic utility, benchmarking enables example based learning, offering success stories or pathways to progress based on the experiences of other countries.

Our framework is grounded in current understanding of what the metaverse could become, which will continue to evolve. It is our aim that as this index develops in the future, it supports countries in developing inclusive metaverse ecosystems as well as the emergence of a successful and inclusive global metaverse.

Inclusive Metaverse Index framework structure

Availability — **Access** — **Affordability**

The existence and maturity of physical and digital infrastructure required for a metaverse ecosystem to develop in a country.

Refers to the fundamental *availability* of underlying and key technologies and their *affordability*.

The costs incurred by consumers, firms and governments to access the metaverse ecosystem.

Digital infrastructure
Coverage of internet infrastructure, including fixed broadband, Wi-Fi, 4G and 5G access, as well as internet exchange points.

Internet access and speed
The quality of the internet in terms of bandwidth capacity, as well as speed and latency of fixed and mobile broadband connections.

User hardware
Key technologies needed to develop the metaverse, such as AR and VR devices and other user hardware, edge and cloud computing, and AI.

Internet cost
The cost of accessing the internet either via fixed broadband connection or mobile data.

User hardware cost
The cost of hardware to access the metaverse ecosystem.

Relevance — **Engagement** — **Readiness**

Awareness of the metaverse, and the extent to which the metaverse ecosystem has current and potential value to individuals and organisations within a country, which is important to stimulate interest and adoption.[56]

Comprises the *readiness* of countries to engage with the metaverse in a safe and secure manner, as well as its *relevance* for current and potential users.

The ability of individuals and organisations to engage with and contribute to the metaverse in a safe and responsible manner.

Awareness
The level of awareness towards the metaverse among the general population.

Value proposition
The potential for metaverse content and services to stimulate beneficial economic or social outcomes.

Usage
The extent of engagement with the metaverse and the quality of the experience.

Digital literacy
The skills that prepare users to participate in the metaverse.

Talent
Human capital for creating content and developing metaverse platforms.

Trust and safety
Promotion of a positive culture and social norms, as well as the prevention of harm within the metaverse ecosystem.

Cyber-security
A country's ability to prevent and respond to cybersecurity risks within the metaverse.

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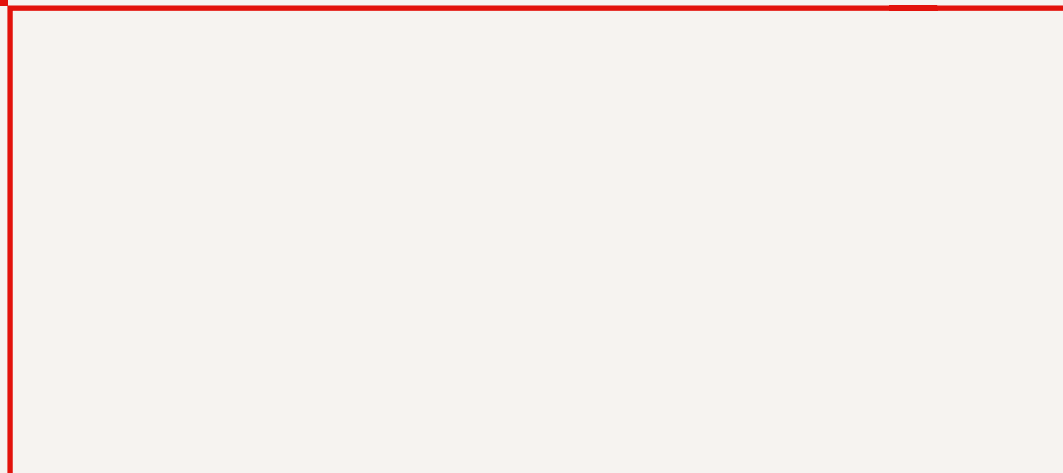
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