

Global Future Council
on Metaverse



Responsible Metaverse Maturity Model

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Governance dimension

Definition

Evaluates the effectiveness of governance structures in place to ensure ethical decision-making, accountability and transparency within the metaverse.

TABLE 1 Key attributes and definitions

Key attributes	Definitions
Policy development	The creation, implementation and revision of policies governing the metaverse environment.
Regulatory compliance	Adherence to legal, ethical and industry standards and regulations within the metaverse.
Stakeholder engagement	The involvement and participation of various stakeholders in the governance process.
Transparency	Clarity, openness and accountability in operations, decisions and governance processes.
Security	Assuring that security risks related to metaverse users (people, avatars, digital twins etc.) and assets (including data, identities, financial assets, infrastructure etc.), are proactively identified, prioritized and managed.

TABLE 2 Maturity levels

Maturity levels	Definitions
Emerging (level 1)	An organization is just beginning to understand the importance of responsible technology. They may have started some initiatives, but these are often ad-hoc and not yet embedded in the organization's culture or processes.
Developing (level 2)	An organization has made a commitment to responsible technology and has started to implement policies and procedures. However, these efforts may not be fully integrated across the organization, and there may still be areas where the organization falls short.
Mature (level 3)	An organization has fully integrated responsible technology into its culture and operations. They have clear policies and procedures in place, and all employees understand their roles and responsibilities. The organization continually monitors and improves its practices to ensure they remain effective and up to date.

1.1 Key attribute evaluation criteria

Policy development

Emerging (level 1):

- 1 Basic governance and security policies (e.g. initial codes of conduct for user interactions).
 - 2 Policies lack comprehensive coverage (e.g. general guidelines without specifics for complex scenarios).
 - 3 Minimal stakeholder input in policy formation (e.g. policies formulated with limited user or expert consultation).
 - 4 Infrequent/ad-hoc policy creation, review and updates (e.g. rarely updating governance policies, or creating policies in response to incidents rather than through a planned strategy).
 - 5 Limited alignment with industry standards (e.g. governance practices not fully aligned with emerging industry norms).
-

Developing (level 2):

- 1 Detailed and evolving governance policies (e.g. regularly updated policies reflecting new challenges and scenarios).
 - 2 Inclusion of diverse perspectives in policy-making (e.g. actively seeking input from a wide range of stakeholders).
 - 3 Structured policy review and revision processes (e.g. formalized procedures for regularly reviewing and updating policies).
 - 4 Better alignment with advanced industry standards (e.g. proactive adaptation to advanced industry standards and best practices).
 - 5 Policies informed by global best practices (e.g. integrating insights from global governance trends and expert panels).
-

Mature (level 3):

- 1 Comprehensive and dynamic policy framework (e.g. policies that are adaptive and inclusive of emerging trends and technologies).
- 2 Deep stakeholder collaboration in policy-making (e.g. co-creation of policies with diverse stakeholder groups).
- 3 Regular, proactive policy updates and revisions (e.g. agile response to technological, legal and social changes).
- 4 Leadership in setting industry standards (e.g. pioneering new governance models and best practices).
- 5 Policies reflect cutting-edge practices and innovation (e.g. integrating advanced ethical standards and innovative governance mechanisms).

Suggested survey questions for maturity assessment

How clear and applicable do you find the rules for behaviour in the metaverse?

- A. They're pretty basic and don't cover many situations.
 - B. They're clear for most situations, though updates could be more frequent.
 - C. The rules are comprehensive, regularly updated and easy to follow.
-

Have you had a chance to share your thoughts on the platform's rules or policies?

- A. No, I haven't seen any way to do that.
 - B. Once or twice, through surveys or feedback forms.
 - C. Yes, there are regular opportunities for input on policy changes.
-

Do you feel the platform's policies keep up with new challenges and changes?

- A. Not really, they seem a bit outdated.
 - B. Somewhat, but there's room for quicker updates.
 - C. Absolutely, policies adapt quickly to new technologies and user needs.
-

Are the governance practices on the platform in line with what you expect from a leading metaverse service?

- A. They lag behind what I've seen elsewhere.
 - B. They're getting there, aligning more with industry standards.
 - C. Yes, they often set the standard for best practices in the industry.
-

How well do the platform's policies reflect a global perspective and diverse user base?

- A. There's little evidence of a global or diverse perspective.
- B. They're starting to include more diverse views and global practices.
- C. Policies are clearly informed by global trends and a commitment to diversity.

Regulatory compliance

Emerging (level 1):

- 1 Basic compliance with essential regulations (e.g. adherence to fundamental local and international data protection, security and content laws).
 - 2 Reactive approach to regulatory changes (e.g. updating policies primarily in response to regulatory penalties).
 - 3 Minimal documentation and tracking of compliance (e.g. sporadic record-keeping of compliance activities).
 - 4 Limited legal support for compliance issues (e.g. basic legal consultations in response to compliance failures).
 - 5 Low awareness of regulatory landscape among staff (e.g. staff not regularly trained on regulatory changes).
-

Developing (level 2):

- 1 Systematic approach to regulatory compliance (e.g. comprehensive compliance programmes and regular training).
 - 2 Proactive identification of compliance requirements (e.g. actively monitoring for regulatory changes and preparing in advance).
 - 3 Regular compliance audits (e.g. scheduled audits to ensure adherence to laws and regulations) and risk assessments (both procedural and technical risk assessments such as penetration tests, vulnerability assessments etc.).
 - 4 Established processes for addressing compliance issues (e.g. standardized procedures for handling and remedying compliance breaches).
 - 5 Ongoing legal support for compliance (e.g. continuous engagement with legal experts for compliance advice and updates).
-

Mature (level 3):

- 1 Advanced, integrated compliance systems (e.g. sophisticated compliance management tools and technologies).
- 2 Anticipatory compliance and security risk strategy and architecture design (e.g. strategic planning to pre-emptively address potential regulatory and cybersecurity challenges).
- 3 Comprehensive security risk and compliance documentation (e.g. detailed records and reports covering all aspects of compliance, security risks and architecture principles).
- 4 Zero tolerance for regulatory breaches (e.g. strict enforcement and immediate corrective actions).
- 5 Strategic legal partnerships for compliance and cybersecurity (e.g. collaborating with leading law firms to innovate in regulatory compliance, law enforcement, incident response teams, penetration test firms, code-auditors etc.).

Suggested survey questions for maturity assessment

How confident are you in the platform's adherence to legal and regulatory requirements?

- A. Somewhat confident, though it seems like the minimum is being done.
 - B. Fairly confident, they seem proactive about compliance.
 - C. Very confident, the platform goes above and beyond in compliance efforts.
-

Do you notice the platform taking steps to address compliance before issues arise?

- A. It feels more reactive than proactive.
 - B. Yes, there seems to be a concerted effort to stay ahead.
 - C. Definitely, the platform anticipates changes and prepares in advance.
-

How transparent is the platform about its compliance practices and any issues that arise?

- A. Transparency is minimal; I rarely hear about compliance efforts.
 - B. There's some communication, but it could be more detailed.
 - C. Very transparent, with regular, detailed updates on compliance.
-

How well-supported do you feel when it comes to understanding your rights and the platform's compliance obligations?

- A. Support is limited; I often have to look for information myself.
 - B. There's good support, including resources and occasional guidance.
 - C. Excellent support, with easy access to information and resources.
-

Are compliance and security topics openly discussed and addressed with the user community?

- A. Rarely, it's not a common topic of open discussion.
- B. Occasionally, especially in response to specific issues.
- C. Regularly, with a clear commitment to user education, adoption and dialogue.

Stakeholder engagement

Emerging (level 1):

- 1 Limited stakeholder identification and involvement (e.g. identifying key stakeholders but not actively involving them in decision-making).
 - 2 Minimal channels for stakeholder communication (e.g. basic communication channels like email or infrequent meetings).
 - 3 Infrequent stakeholder feedback mechanisms (e.g. rare surveys or forums to gather stakeholder input).
 - 4 Low prioritization of stakeholder perspectives (e.g. stakeholders' opinions not being a major factor in decision-making).
 - 5 Minimal transparency with stakeholders (e.g. limited disclosure of decision-making processes to stakeholders).
-

Developing (level 2):

- 1 Structured stakeholder engagement processes (e.g. regular stakeholder meetings and active dialogue channels).
 - 2 Diverse stakeholder communication platforms (e.g. use of social media, forums and interactive webinars for stakeholder communication).
 - 3 Regular collection of stakeholder feedback (e.g. frequent surveys and feedback sessions to gauge stakeholder opinions).
 - 4 High consideration of stakeholder insights in decision-making (e.g. stakeholder input directly influencing policy changes).
 - 5 Increased transparency with stakeholders (e.g. regular reports and open forums discussing governance decisions and processes).
-

Mature (level 3):

- 1 Deep, ongoing stakeholder engagement and co-creation in governance (e.g. collaborative policy development initiatives with stakeholders).
- 2 Advanced platforms for stakeholder interaction (e.g. dedicated portals and virtual town halls for stakeholder engagement).
- 3 Continuous stakeholder feedback integration (e.g. real-time feedback mechanisms and agile response to stakeholder concerns).
- 4 Strategic stakeholder partnership development (e.g. forming long-term partnerships with key stakeholder groups for mutual governance goals).
- 5 High level of transparency and open communication (e.g. comprehensive disclosure of governance activities, decision-making rationale and plans).

Suggested survey questions for maturity assessment

How included do you feel in the platform decision-making process?

- A. I don't feel very included; it seems decisions are made behind closed doors.
 - B. There are some efforts to include user opinions through surveys or forums.
 - C. I feel fully included, with many channels open for my input and feedback.
-

How effective are the communication channels between you and the platform?

- A. Basic, often feeling one-way.
 - B. Good, with multiple platforms for communication.
 - C. Excellent, with dynamic two-way communication channels.
-

How often do you provide feedback to the platform, and do you see any actions taken based on it?

- A. Not often, and I'm not sure if feedback is used.
 - B. Regularly, and sometimes I see changes that might reflect user feedback.
 - C. Frequently, and I often see direct results from the feedback provided by the community.
-

Do you believe the platform values your input and that of the broader community?

- A. It doesn't seem like response to user input is a priority.
 - B. Yes, to an extent, especially on larger issues.
 - C. Definitely, there's a strong emphasis on community input shaping the platform.
-

How transparent is the platform in implementing user feedback into its governance and policy updates?

- A. There's limited transparency, it's challenging to see how feedback is integrated.
- B. Somewhat, but it would benefit from more clarity regarding the impact of user feedback.
- C. Extremely transparent, the impact of user feedback on governance decisions and policy updates is fully visible.

Transparency

Emerging (level 1):

- 1 Basic transparency in operations, accountability and decisions (e.g. general information about governance processes made public).
 - 2 Limited public reporting and communication (e.g. infrequent updates or reports on governance matters).
 - 3 Minimal clarity in decision-making processes (e.g. decisions made without clear or public rationale).
 - 4 Infrequent engagement with external transparency standards (e.g. rare consideration of external transparency benchmarks or standards).
 - 5 Low stakeholder trust in transparency measures (e.g. stakeholders express doubt about the sincerity or effectiveness of transparency efforts).
-

Developing (level 2):

- 1 Comprehensive operational disclosures and accountability (e.g. detailed and regular reporting on governance activities and decisions).
 - 2 Regular and detailed public reporting (e.g. frequent updates and transparent communication about governance issues).
 - 3 Clear and understandable decision-making processes (e.g. providing clear explanations and justifications for decisions).
 - 4 Consistent communication with stakeholders (e.g. regular dialogues and updates to ensure stakeholder awareness and understanding).
 - 5 Specific transparency objectives and measures (e.g. setting clear goals and metrics for transparency and regularly assessing progress).
-

Mature (level 3):

- 1 Full transparency in all operations and accountability (e.g. all governance activities and decisions are openly shared and accessible).
- 2 Advanced and real-time public reporting mechanisms (e.g. real-time updates and interactive platforms for sharing governance information).
- 3 Fully transparent and inclusive decision-making (e.g. inclusive processes allowing stakeholder observation and input into decision-making).
- 4 Deep, ongoing dialogue with all stakeholders (e.g. continuous and open communication channels for stakeholder engagement and feedback).
- 5 Benchmarking transparency against best practices (e.g. regularly comparing transparency practices against global standards and leading examples).

Suggested survey questions for maturity assessment

How well-informed do you feel about the decisions and operations of the metaverse platform?

- A. Information is sparse and often vague.
 - B. I receive some updates, but I'd prefer more depth and frequency.
 - C. I'm very well informed, with frequent, detailed insights into platform operations.
-

How often does the platform share updates or reports on its governance and operational activities?

- A. Only occasionally, and usually only after significant events.
 - B. There are regular updates, though they could be more detailed.
 - C. Updates are provided in real-time, with comprehensive details and open forums for discussion.
-

Do you understand how decisions are made within the platform, including who is involved and the rationale behind them?

- A. The decision-making process seems opaque to me.
 - B. I have a general idea but could benefit from clearer explanations.
 - C. Yes, the process is transparent, with clear justifications for decisions shared openly.
-

Is the platform proactive in engaging with and meeting external standards of transparency?

- A. It doesn't seem to prioritize external transparency standards.
 - B. Efforts are being made to align with these standards.
 - C. The platform is a leader in setting and exceeding transparency benchmarks.
-

How much trust do you place in the platform's commitment to transparency and openness with its user base and stakeholders?

- A. I'm sceptical due to a lack of visible commitment.
- B. Moderately trusting, as I've seen improvements over time.
- C. Highly trusting, backed by consistent, open communication and engagement practices.

Security

Emerging (level 1):

- 1 **Basic data fusion protocols:** Recognizes the need to securely manage multi-modal user data but lacks a sophisticated system. Example: simple encryption for user-avatar interactions data storage.
 - 2 **Rudimentary trust management:** Trust is managed through basic verification, such as email confirmation. Example: single-factor authentication for user identity verification.
 - 3 **Initial consensus mechanisms:** Uses basic consensus protocols for decision-making among users. Example: simple majority voting for community decisions within the virtual environment.
 - 4 **Basic service authorization:** Simple permission systems for services with minimal scalability. Example: manual access control lists for different virtual areas or services.
 - 5 **Homogeneous world interfaces:** Supports limited hardware and software interfaces. Example: standardized avatars and environments that work only with specific headsets or devices.
-

Developing (level 2):

- 1 **Advanced data fusion systems:** Implements more sophisticated multi-modal data fusion protocols with basic anomaly detection. Example: secure multi-tenant data storage with anomaly detection systems.
 - 2 **Enhanced trust management frameworks:** Develops a framework for trust management that begins to address the real-virtual boundary blurring. Example: multi-factor authentication and digital watermarking for content verification.
 - 3 **Developing consensus algorithms:** Implements more refined consensus protocols that handle larger and more varied user bases. Example: distributed ledger technologies for property rights management within the metaverse.
 - 4 **Scalable authorization systems:** More adaptive service authorization systems with some level of compliance auditing. Example: role-based access control with audit trails for compliance checks.
 - 5 **Interoperability in heterogeneous environments:** Begins to address hardware and software diversity with cross-platform support. Example: middleware solutions that allow different devices to interact within the same virtual space.
-

Mature (level 3):

- 1 **Integrated data fusion and analysis:** Comprehensive systems that securely integrate multi-modal user data and use advanced analytics for interaction security. Example: AI-powered anomaly detection and predictive analytics.
- 2 **Sophisticated trust and verification mechanisms:** Complex systems that manage trust across real and virtual boundaries with advanced techniques like blockchain-based identity verification. Example: biometric verification systems.
- 3 **Robust consensus frameworks:** Advanced consensus mechanisms capable of handling dynamic, massive entity interactions. Example: real-time consensus algorithms with high fault tolerance and minimal latency.
- 4 **Comprehensive authorization and compliance:** Highly scalable, automated systems for service authorization with integrated compliance auditing and enforcement. Example: smart contract-based access control with automated auditing.
- 5 **Seamless interoperability and heterogeneity:** Fully supports a diverse range of hardware and software with seamless interoperability. Example: universal compatibility protocols for all virtual world interactions.

Suggested survey questions for maturity assessment

How secure do you feel your personal information and activities are within the metaverse platform?

- A. Somewhat secure, but I'm aware there could be vulnerabilities.
 - B. Generally secure, with occasional concerns about data protection.
 - C. Extremely secure, with confidence in the platform's advanced security measures.
-

In terms of privacy and data protection, how proactive do you think the platform is?

- A. It reacts to issues more than it prevents them.
 - B. There's a clear effort to be proactive, though not perfect.
 - C. It's ahead of the curve, anticipating and addressing privacy concerns early.
-

How accessible and user-friendly do you find the platform's security settings and information?

- A. They're there but can be hard to understand or navigate.
 - B. Fairly user-friendly, with some guidance provided.
 - C. Very intuitive, with extensive support and education on security settings.
-

How involved do you feel in the development and enhancement of the platform's security practices?

- A. I don't feel involved at all.
 - B. There are some opportunities for feedback on security issues.
 - C. I feel very involved, with regular requests for input and active discussions on security improvements.
-

Does the platform offer clear, understandable resources and support for addressing security concerns or incidents?

- A. Support exists but is minimal and not always helpful.
- B. Yes, there are resources, but navigating them can sometimes be challenging.
- C. Absolutely, with prompt, clear guidance and strong support structures in place for any security concerns.

2

Identity dimension

Definition

Examines the measures in place to protect and manage user identities within the metaverse, addressing issues such as authentication, authorization and data ownership.

TABLE 3 Key attributes and definitions

Key attributes	Definitions
User authentication and anonymity options	Verification and validation of user identities within the metaverse. The ability for users to maintain anonymity or pseudonymity in their interactions.
Avatar embodiment and interaction	Evaluates the technologies and methods enabling users to embody and interact with their avatars, beyond visual customization to enhance user identity, interaction and immersion within the metaverse.
Digital rights management	Protection and management of digital identities, assets and intellectual property rights.

TABLE 4 Maturity levels

Maturity levels	Definitions
Emerging (level 1)	An organization is just beginning to understand the importance of responsible technology. They may have started some initiatives, but these are often ad hoc and not yet embedded in the organization's culture or processes.
Developing (level 2)	An organization has made a commitment to responsible technology and has started to implement policies and procedures. However, these efforts may not be fully integrated across the organization, and there may still be areas where the organization falls short.
Mature (level 3)	An organization has fully integrated responsible technology into its culture and operations. They have clear policies and procedures in place, and all employees understand their roles and responsibilities. The organization continually monitors and improves its practices to ensure they remain effective and up to date.

2.1 Key attribute evaluation criteria

User authentication and anonymity options

Emerging (level 1):

- 1 Basic security protocols and anonymity options, such as simple login methods and pseudonym usage, setting the foundation for user privacy and identity management.
 - 2 Limited verification processes with minimal ability for the platform to identify users, focused on initial steps towards safeguarding against misuse while respecting privacy.
 - 3 Rudimentary efforts in fraud detection and promoting anonymity, emphasizing the importance of privacy through basic user education and minimal security measures.
 - 4 Infrequent updates to security measures and anonymity protections, reflecting the early stages of commitment to evolving user safety and privacy needs.
 - 5 Initial user awareness campaigns on the significance of secure authentication practices and the option for anonymity, aiming to spread a basic understanding of digital identity rights.
-

Developing (level 2):

- 1 Introduction of two-factor authentication and more sophisticated anonymity options, ensuring secure access while maintaining user privacy.
 - 2 Implementation of content restriction based on age, using improved verification methods that balance anonymity with the need to prevent underage access to adult content.
 - 3 Regular updates on security protocols and anonymity options, alongside enhanced fraud detection mechanisms, to better protect users and their digital identities.
 - 4 Scheduled reviews of the effectiveness of authentication and anonymity measures, with a focus on fine-tuning protections against misuse without compromising user privacy.
 - 5 Increased educational efforts aimed at raising user awareness about the benefits and responsibilities of secure authentication and anonymity, encouraging a safer online community.
-

Mature (level 3):

- 1 Advanced authentication mechanisms combined with state-of-the-art anonymity features, facilitating secure and untraceable user interactions while allowing platform-level identification in critical scenarios.
- 2 Continuous, comprehensive verification and protection strategies for both identity authentication and anonymity, including sophisticated mechanisms to ensure a safe environment for all users.
- 3 Strong advocacy for both security and the right to anonymity, supported by advanced fraud detection technologies to cultivate a respectful and secure online community.
- 4 Ongoing improvements in security technologies and anonymity protections, reflecting the platform's proactive stance on addressing evolving threats and respecting user privacy.
- 5 High level of user engagement with security and anonymity initiatives, backed by community-led educational programs aimed at promoting a safe, inclusive and privacy-respecting digital space.

Suggested survey questions for maturity assessment

When you log in to the metaverse, what security steps do you go through?

- A. I just use my username and password.
 - B. I'm asked for a code from my phone or email in addition to my password.
 - C. I use my fingerprint, face recognition or a security token, along with my password.
-

How does the metaverse ensure that users are who they say they are, especially for age-restricted areas?

- A. I haven't noticed much; maybe just entering a birthdate.
 - B. I had to provide some extra verification for age-restricted areas.
 - C. The platform has a thorough check, maybe even real-time monitoring, to keep things appropriate for all ages.
-

Have you noticed how the platform handles suspicious activity or protects your privacy?

- A. Not really; I guess they do the basics.
 - B. They seem to update security features and talk about privacy sometimes.
 - C. Yes, they're always on top of it with frequent updates and clear information on keeping my data safe.
-

Do you get information or education about keeping your identity safe in the metaverse?

- A. I've seen a few basic tips or alerts.
 - B. Yes, there are occasional guides or tutorials on privacy and security.
 - C. Absolutely, there's a lot of helpful information and even interactive learning on how to stay safe.
-

How does the platform handle your wish to remain anonymous or protect your identity?

- A. I can choose a nickname, but that's about it.
- B. There are some privacy settings I can tweak.
- C. I have many options to control how I present myself and protect my identity, even with cutting-edge features.

Avatar embodiment and interaction

Emerging (level 1):

- 1 Comprehensive customization options from the outset, including open and fantasy creature designs, enabled by platform-independent avatar creator markets.
 - 2 Extensive fashion and wearables, reflecting a significant focus on avatar appearance and identity expression through a broad selection of clothing and accessories.
 - 3 Advanced interaction and navigation capabilities, even at this stage, using technologies like full body tracking (FBT) and haptic suits to enhance embodiment.
 - 4 User co-creation and marketplace integration, allowing for the design, upload and commercialization of avatar elements, showcasing platform adaptability to user creativity.
 - 5 Entry into virtual worlds is possible in 2D, using conventional interfaces like screens, keyboards and mice, providing a basic level of immersion and interaction.
-

Developing (level 2):

- 1 Further advanced customization and personalization features, including detailed attire and feature modifications, catering to diverse user preferences and identities.
 - 2 Enrichment of expression capabilities, incorporating advanced animations and expressions for nuanced avatar interaction and communication.
 - 3 Introduction of virtual reality (VR) headsets, additional controllers and trackers for a standard VR setup, including FBT, to elevate the level of avatar embodiment and immersive experiences.
 - 4 Inclusion of voice modulation capabilities and real-time avatar updates, reflecting user moods or statuses, facilitated by platform features or third-party software, prevalent across varying stages of maturity.
 - 5 Deepening user engagement in development through direct involvement in testing and feedback loops, cultivating a collaborative ecosystem between users and platform developers.
-

Mature (level 3):

- 1 Fully dynamic and highly interactive avatars capable of complex interactions, emotional responses and customization, including voice modulation and AI-generated avatar features on request.
- 2 Comprehensive libraries of accessories and customizable items, ensuring avatars can continuously evolve to reflect the latest trends and personal identities.
- 3 Full immersion in the metaverse through advanced FBT and haptic feedback technologies, heightening the sensory experience and embodiment within virtual spaces.
- 4 Using generative AI capabilities to dynamically create and adapt avatars based on verbal instructions or user preferences, pushing the boundaries of avatar personalization.
- 5 Platforms involving users in the innovation process, encouraging the community to contribute towards the evolution of avatar technologies and features, thereby adopting a futuristic vision of digital representation.

Suggested survey questions for maturity assessment

How personalized can you make your avatar look and act?

- A. I can pick from some preset looks and basic actions.
 - B. There's a good range of outfits, looks and expressions I can choose.
 - C. It's very detailed; I can tweak virtually every aspect and even have it mimic my real-life movements.
-

When interacting in the metaverse, how immersive does it feel?

- A. It's pretty basic, like moving through a video game.
 - B. It's getting there, especially if I use VR gear.
 - C. It's incredibly immersive, almost like being in another world, with realistic movements and interactions.
-

How often do new features or updates for avatars come out?

- A. Rarely, it stays pretty much the same.
 - B. Every now and then, I see something new to try.
 - C. Regularly, there's always something new to enhance the experience.
-

Can you contribute to or influence how avatars are designed or used in the metaverse?

- A. Not really, I just use what's available.
 - B. There might be ways to give feedback or customize within certain limits.
 - C. Yes, there's a community aspect where we can create and share our designs or even sell them.
-

What devices do you use to enter and navigate the metaverse, and how does it feel?

- A. Just my computer or phone; it's straightforward.
- B. I use a VR headset which makes it more engaging.
- C. With a full setup like VR, trackers or haptic suits, it feels like I'm truly inside the metaverse.

Digital rights management

Emerging (level 1):

- 1 Introduction of digital content ownership and copyright systems, laying the foundation for asset protection within virtual environments.
 - 2 Initial adoption of blockchain technology for tracking ownership, providing a basic but effective record of digital asset creation and ownership unique to each platform.
 - 3 Implementation of minimal yet existent enforcement mechanisms for rights violations, indicating the presence of authentication methods and the capability for some level of rights management action.
 - 4 A focus on the development of rights management technologies and raising user awareness about digital content rights, aiming to create a basic understanding and framework for asset protection.
-

Developing (level 2):

- 1 Enhanced digital asset protection through robust copyright and digital rights management (DRM) systems, catering to a wider range of content types.
 - 2 Comprehensive asset tracking using detailed logs and blockchain technology, enhancing clarity around provenance and ownership, though primarily within single-platform constraints.
 - 3 Regular enforcement of rights violations supported by improved integration of authentication and age/ID verification processes, showcasing a more systematic approach to rights management.
 - 4 Periodic updates to DRM technologies coupled with increased efforts to educate users on their digital rights, protections and the significance of preventing asset sharing and theft.
-

Mature (level 3):

- 1 Advanced DRM solutions employing next-generation technology and blockchain for enhanced protection and interoperability of digital content across various platforms.
- 2 Full lifecycle asset tracking from creation to end-of-life, using blockchain to ensure asset uniqueness and facilitate cross-platform operability.
- 3 Proactive and automated enforcement of digital rights, seamlessly integrated with comprehensive user identification systems to address impersonation risks and avatar theft.
- 4 Continuous evolution of rights management solutions through the development and implementation of specific laws and regulations tailored to digital asset ownership and copyright in the metaverse.
- 5 A strong focus on user empowerment, providing tools, legal frameworks and initiatives that enable users to actively manage and safeguard their digital rights, considering potential legal implications and the risk of impersonation.

Suggested survey questions for maturity assessment

How familiar are you with the regulations regarding ownership or creation of objects in the metaverse?

- A. I am aware there are fundamental rules about permissible and non-permissible actions.
 - B. I have a good understanding; there appears to be a system for tracking and managing digital creations.
 - C. I'm extremely knowledgeable; I comprehend how blockchain or other technologies secure my creations and rights.
-

What happens if someone uses your digital creation without permission?

- A. I'm not sure there's much that can be done.
 - B. The platform has a way to report and possibly resolve these issues.
 - C. There's a robust system in place to detect this automatically and protect my work.
-

Do you feel like you have control over your digital assets and creations?

- A. Somewhat, but it feels pretty basic.
 - B. Yes, with the tools provided, I can keep track of and manage my assets.
 - C. Absolutely, I have full control and trust in the platform's ability to secure my digital property.
-

How often are you updated about rights management and changes in how your digital content is protected?

- A. Not often; information is scarce or hard to find.
 - B. Periodically, through platform updates or community forums.
 - C. Regularly, with comprehensive updates and active discussions on rights management.
-

What tools or resources are available to you for managing the rights to your digital creations?

- A. Very few; I'm mostly on my own to figure it out.
- B. Some tools are available, like content tracking and basic rights management systems.
- C. A wide range of tools, including blockchain integration for asset tracking and sophisticated DRM solutions, is at my disposal.

3

Literacy dimension

Definition

Focuses on the level of digital and metaverse literacy among participants and users, ensuring that individuals can navigate and engage with the virtual world effectively.

TABLE 5 Key attributes and definitions

Key attributes	Definitions
Educational resources	Availability and provision of learning materials and programmes to educate users about the metaverse, including navigating and using the metaverse effectively, safely and responsibly.
Change management and culture adoption	Emphasizes guiding the adoption of metaverse technologies as a cultural shift, promoting adaptability and integrating digital norms into everyday practices. Facilitates the smooth transition to embracing the metaverse as a fundamental aspect of modern digital culture.
Community support	Support systems such as forums, help centres or communities for user assistance and knowledge sharing.
User competency assessment	Evaluating and assessing the skills and understanding of users in the metaverse.

TABLE 6 Maturity levels

Maturity levels	Definitions
Emerging (level 1)	<p>A organization is just beginning to understand the importance of responsible technology.</p> <p>They may have started some initiatives, but these are often ad-hoc and not yet embedded in the organization's culture or processes.</p>
Developing (level 2)	<p>An organization has made a commitment to responsible technology and has started to implement policies and procedures.</p> <p>However, these efforts may not be fully integrated across the organization, and there may still be areas where the organization falls short.</p>
Mature (level 3)	<p>A organization has fully integrated responsible technology into its culture and operations.</p> <p>They have clear policies and procedures in place, and all employees understand their roles and responsibilities. An awareness on desired behaviour with responsible usage of the metaverse and its resources permeates throughout the whole organization.</p> <p>The organization continually monitors and improves its practices to ensure they remain effective and up to date.</p>

3.1 Key attribute evaluation criteria

Educational resources

Emerging (level 1):

- 1 Introduction of fundamental metaverse concepts, emphasizing communication skills using in-world tools like text and voice chat.
 - 2 Guidance on basic navigation and interaction within virtual environments, coupled with an awareness of digital citizenship principles.
 - 3 Inclusion of simple insights into virtual economies, clarifying basic transactions and virtual currency usage.
 - 4 Basic training in the technical aspects of the metaverse, such as using VR and augmented reality (AR) interfaces.
 - 5 Foundational education on critical thinking and media literacy within the metaverse context, encouraging responsible digital behaviour.
-

Developing (level 2):

- 1 Expansion of educational content to cover advanced communication tools and interaction techniques within the metaverse.
 - 2 Regular updates on navigating complex virtual environments and a deeper understanding of virtual economies and their impact.
 - 3 Development of materials that address the software, hardware and blockchain technology underpinning the metaverse.
 - 4 Promotion of media literacy, emphasizing critical evaluation of information and responsible community participation.
 - 5 Integration of legal and regulatory considerations into learning materials, preparing users for compliance with evolving metaverse frameworks.
-

Mature (level 3):

- 1 Comprehensive resources on sophisticated communication and interaction within the metaverse, including emotional expressions and advanced gestures.
- 2 Advanced training programmes that reflect dynamic economic systems and support professional development through virtual networking.
- 3 In-depth modules on the technological foundations of the metaverse, ensuring technical literacy and effective usage of cutting-edge access tools.
- 4 Extensive materials on global legal and regulatory environments, offering insight into intellectual property and jurisdiction in the metaverse.
- 5 Collaborative initiatives to cultivate a community of digital citizens who are well-versed in protecting personal information and navigating digital spaces ethically.

Suggested survey questions for maturity assessment

When learning the ropes of the metaverse, how clear and helpful have you found the instructions on chatting and moving around?

- A. They're pretty basic; I've had to figure out a lot on my own.
 - B. Fairly helpful, though I wish they'd update the guides with new features.
 - C. Super clear and detailed; I felt confident exploring right away.
-

How equipped do you feel to handle transactions or understand the economy within the metaverse, based on the provided resources?

- A. Somewhat; the basics are covered, but more complex topics feel murky.
 - B. More informed now, especially with updates that explain recent changes.
 - C. Very well-prepared; I've learned not just how things work but also the why behind them.
-

Have you noticed the educational materials keeping pace with new technologies and changes in the metaverse?

- A. They tend to lag behind; by the time materials are updated, there are new changes.
 - B. There's an effort to keep up, with periodic updates to the learning content.
 - C. Yes, it feels like they're always one step ahead, making it easy to keep up with innovations.
-

Do the resources encourage you to think critically about your actions and interactions within the metaverse?

- A. They touch on it, but it feels more like an afterthought.
 - B. Yes, there's a stronger emphasis on ethical behaviour and understanding the impact of our actions.
 - C. Absolutely, it's been eye-opening to learn about digital ethics and how to navigate complex situations responsibly.
-

Is there attention to helping you understand the legal aspects of metaverse activities, like copyright or privacy laws?

- A. Barely; it's mentioned, but I don't feel confident about the details.
- B. It's getting better, especially with resources that outline how laws apply to different scenarios.
- C. Yes, there's comprehensive coverage that makes me feel well-versed in how to stay compliant and respectful of others' rights.

Change management and culture adoption

Emerging (level 1):

- 1 Awareness campaigns that introduce communication and navigation within the metaverse, setting the stage for a cultural shift.
 - 2 Basic training sessions on digital citizenship and virtual economies, reinforcing the importance of responsible metaverse engagement.
 - 3 Guidelines that encourage critical thinking and an understanding of the metaverse's underlying technologies.
 - 4 Efforts to address misconceptions related to the complexity and safety of the metaverse, promoting informed participation.
 - 5 Creation of feedback channels to discuss technical literacy and the real-world implications of metaverse activities.
-

Developing (level 2):

- 1 Comprehensive change management strategies that include training on advanced in-world literacy and out-world technical applications.
 - 2 Programs that facilitate skill development in metaverse navigation, virtual economy participation and professional networking.
 - 3 Establishment of cross-functional teams to integrate metaverse literacy into organizational and cultural practices.
 - 4 Regular assessment of cultural adoption progress, measuring advancements in digital citizenship and critical media literacy.
 - 5 Promotion of continuous education on the evolving legal and regulatory landscape of the metaverse.
-

Mature (level 3):

- 1 Leadership programmes that advocate for sophisticated communication skills and deep understanding of virtual economies within the metaverse.
- 2 Personalized learning paths that cover the spectrum from technical literacy to critical thinking and professional development in virtual environments.
- 3 Integration of digital citizenship into the core values of organizations, fostering a culture that aligns in-world and out-world behaviours.
- 4 Proactive adaptation of training and resources to the latest technological trends and legal frameworks governing the metaverse.
- 5 Establishment of a global community that continuously exchanges knowledge on metaverse literacy, promoting lifelong learning and innovation.

Suggested survey questions for maturity assessment

How aware are you of initiatives aimed at making the metaverse a more welcoming and inclusive space?

- A. I've seen a few attempts, but it doesn't seem widespread.
 - B. There's a noticeable effort, with campaigns and training sessions becoming more common.
 - C. Very aware. It feels like there's a strong, community-wide push towards inclusivity and respect.
-

In terms of skill development for navigating or contributing to the metaverse, how supported do you feel?

- A. There's some basic support, but advanced topics aren't well covered.
 - B. The support is growing, with more advanced workshops and materials now available.
 - C. I feel fully supported, with a wide range of resources for all levels of expertise and interests.
-

How well do you think the platform integrates ethical considerations and digital citizenship into its culture and education?

- A. It's mentioned, but I haven't seen much practical integration.
 - B. There's a good effort, with increasing discussion and guidelines on these topics.
 - C. Exceptionally well. Ethics and digital citizenship are core to the community's values and teachings.
-

Are you encouraged to keep learning and adapting as the metaverse evolves?

- A. Not much. Once you're set up, you're on your own.
 - B. Somewhat. Especially when new features roll out or when there are significant changes.
 - C. Constantly. There's always something new to learn, and the platform actively promotes ongoing education.
-

Does the platform facilitate an understanding of the metaverse from a global perspective, considering diverse legal and cultural norms?

- A. Not really. It feels quite narrow in scope.
- B. It's improving, with more resources touching on international aspects.
- C. Definitely. I've gained a broad understanding of how the metaverse interacts with different cultures and legal systems.

Community support

Emerging (level 1):

- 1 Support forums offer basic guidance on in-world communication tools and navigation and provide a platform for discussing digital citizenship.
 - 2 Occasional expert contributions to forums, offering insights on the underlying technologies of the metaverse and cultivating technical literacy.
 - 3 Encouragement of user-to-user support in understanding the fundamentals of virtual economies and legal frameworks.
 - 4 Sporadic updates to community resources aimed at improving basic out-world critical thinking and media literacy skills.
 - 5 Initiatives to engage the community in discussions about professional development opportunities within the metaverse.
-

Developing (level 2):

- 1 Enhanced community forums actively discuss advanced metaverse interactions and the real-world applications of in-world experiences.
 - 2 Regular contributions from experts on critical thinking, media literacy and navigating virtual economies effectively.
 - 3 A strong culture of peer support that helps users understand and harness the metaverse for educational and professional development.
 - 4 Consistent updates to community resources, integrating the latest trends in metaverse technology and out-world implications.
 - 5 Community events and activities designed to encourage sharing of knowledge on technical literacy and digital citizenship.
-

Mature (level 3):

- 1 Advanced support platforms with AI assistance offer deep dives into complex in-world and out-world metaverse concepts.
- 2 Expert-led initiatives and mentorship programmes focus on cultivating a sophisticated understanding of metaverse economies, technology and legal considerations.
- 3 A knowledge-sharing culture that spans from in-world etiquette to out-world regulatory awareness, emphasizing collaboration and continuous learning.
- 4 Dynamic updates to community resources based on collaborative efforts, reflecting the convergence of in-world experiences with out-world professional practices.
- 5 Global community outreach that enriches the metaverse experience with diverse perspectives, promoting cross-cultural and interdisciplinary learning.

Suggested survey questions for maturity assessment

How supported do you feel by the community or available forums when you need help or have questions about the metaverse?

- A. It can be hit or miss; sometimes I find answers, other times I feel lost.
 - B. Increasingly supported, with more active forums and expert involvement.
 - C. I always feel supported; there's a strong sense of community ready to help with any question.
-

How accessible and helpful do you find expert advice within the community on topics like technology or metaverse economies?

- A. It's rare to see experts chime in, which makes it hard to find reliable information.
 - B. More experts are participating, offering valuable insights that have helped me understand complex topics.
 - C. Expert advice is readily available and incredibly helpful, making complex topics accessible and understandable.
-

How frequently do you engage in activities or discussions that enhance your understanding or skills within the metaverse?

- A. Not very often. There seems to be a lack of organized activities or engaging discussions.
 - B. Regularly, as there are more events, workshops and forums that cater to a wide range of interests and skill levels.
 - C. All the time. There's a vibrant calendar of community events and discussions that constantly boost my skills and knowledge.
-

Do you feel the community efforts effectively promote professional development and educational growth within the metaverse?

- A. Somewhat. There are hints of this, but it's not a major focus yet.
 - B. Yes, there's a growing emphasis on professional development, with more resources dedicated to learning and growth.
 - C. Absolutely. Professional development is a key pillar of the community, with extensive support and opportunities for advancement.
-

How well do community resources keep pace with the latest metaverse technologies and trends?

- A. They try, but often the resources feel outdated or too general.
- B. Quite well. There's an effort to update resources and discussions to reflect new technologies and trends.
- C. Exceptionally well. The community is always on the cutting edge, offering insights and resources on the very latest developments.

User competency assessment

Emerging (level 1):

- 1 Quizzes and feedback forms to evaluate basic in-world communication skills and understanding of navigation tools.
 - 2 Simple tools to measure user familiarity with metaverse technology basics, such as VR and AR, and their real-world applications.
 - 3 Rare updates to assessment tools, which might include evaluations of users' understanding of virtual economies and digital citizenship principles.
 - 4 Assessments are loosely connected to educational content, focusing on users' ability to engage responsibly in digital communities.
 - 5 Minimal focus on developing skills that translate metaverse experiences to real-world competency and understanding.
-

Developing (level 2):

- 1 Tiered assessments that evaluate a range of skills from in-world navigation to out-world technical applications.
 - 2 Periodic revisions of assessment tools to ensure they remain current with metaverse developments and their real-world implications.
 - 3 Assessments tied to training programmes, evaluating users' abilities to apply metaverse experiences to professional development and critical thinking.
 - 4 Encouragement of skill development that bridges in-world literacy and out-world digital ethics and media literacy.
 - 5 Use of feedback from assessments to refine both the content and delivery of training programmes, cultivating a robust understanding of in-world and out-world dynamics.
-

Mature (level 3):

- 1 Personalized competency assessments that adapt to the user's progress in both in-world and out-world literacy.
- 2 Continuous innovation in assessment methods, incorporating emerging trends in metaverse technology and their broader societal impacts.
- 3 Assessments are deeply integrated into a comprehensive learning journey, reflecting a user's ability to transition between in-world and out-world environments seamlessly.
- 4 A concerted emphasis on continuous advancement in metaverse skills, digital citizenship and global regulatory frameworks.
- 5 Benchmarking of user competencies against international standards, considering the fusion of metaverse experiences with real-world digital transformation and ethical practices.

Suggested survey questions for maturity assessment.

How often do you encounter quizzes or assessments that gauge your understanding of metaverse basics, like communication tools or navigation?

- A. Rarely, if ever. It seems like once you're in, you're expected to figure things out on your own.
 - B. Occasionally, especially when updates or new features are introduced.
 - C. Regularly. There's a clear pathway of assessments that help me track my learning progress.
-

Are there tools or resources that help you assess your adaptability to new metaverse technologies, such as VR or AR interfaces?

- A. Not really. There's a lack of feedback mechanisms to gauge my progress.
 - B. Yes, there are some tools, but they could be more comprehensive and user-friendly.
 - C. Definitely. I have access to detailed feedback and resources that help me understand my proficiency and areas for improvement.
-

How does the platform support your continuous learning, especially with the rapid evolution of metaverse environments and economies?

- A. Support is minimal. It often feels like I must keep up on my own.
 - B. There's growing support, with updates and resources that address new changes and challenges.
 - C. The support is excellent, with a wealth of resources and regular updates that ensure I'm always well-informed and ahead of the curve.
-

Do you feel the assessments and learning resources bridge the gap between in-world metaverse experiences and real-world applications?

- A. Not really. The focus seems to be more on the in-world experience without much connection to real-world skills.
 - B. Somewhat. There's an effort to make learning applicable both within the metaverse and in real-life scenarios.
 - C. Yes, the learning experiences are perfectly designed to enrich my metaverse engagement and enhance my real-world skills and knowledge.
-

How personalized do you find the learning and assessment process to be in adapting to your specific needs and progress within the metaverse?

- A. It feels quite generic. There's not much customization to fit different learning styles or progress levels.
- B. There's some level of personalization, especially as I progress and give feedback.
- C. The personalization is outstanding. Everything from learning materials to assessments is tailored to my progress, interests and feedback, making my learning experience highly effective and enjoyable.

4

Interoperability dimension

Definition

Assesses the extent to which different platforms and technologies within the metaverse can seamlessly work together to cultivate a more cohesive and interconnected virtual environment.

TABLE 7 Key attributes and definitions

Key attributes	Definitions
Standardization	The adoption of universal standards to ensure seamless metaverse interactions. This includes protocols and accommodations for diverse hardware and user devices enabling a unified metaverse experience.
Platform compatibility	Ensures efficient interoperability among metaverse platforms and integration with other enabling technologies like Web 3.0, digital wallets, blockchain and AI.
Data and identity portability	Facilitates the transfer of user data and virtual identities across platforms, adhering to global data protection regulations and enabling continuity.
Application programming interfaces (API) integration	The effective use of API to enhance connectivity and functionality.

TABLE 8 Maturity levels

Maturity levels	Definitions
Emerging (level 1)	An organization is just beginning to understand the importance of responsible technology. They may have started initiatives, but these are often ad-hoc and not yet embedded in the organization's culture or processes.
Developing (level 2)	An organization has made a commitment to responsible technology and has started to implement policies and procedures. However, these efforts may not be fully integrated across the organization, and there may still be areas where the organization falls short.
Mature (level 3)	An organization has fully integrated responsible technology into its culture and operations. They have clear policies and procedures in place, and all employees understand their roles and responsibilities. The organization continually monitors and improves its practices to ensure they remain effective and up to date.

4.1 Key attribute evaluation criteria

Standardization

Emerging (level 1):

- 1 **Documentation of standards:** Basic guideline documents for interaction protocols. Example: Text files detailing 3D model specifications.
 - 2 **Hardware recognition:** Limited support for major hardware brands. Example: Compatibility with leading VR headset brands.
 - 3 **Interoperability testing:** Ad-hoc testing with some hardware and software configurations. Example: Occasional VR headset and platform compatibility checks.
 - 4 **Basic user experience:** Inconsistent user interface across devices. Example: Different control schemes for VR versus mobile.
 - 5 **Initial compliance framework:** Awareness of the need for compliance with standards. Example: Membership in a standards organization without active participation.
-

Developing (level 2):

- 1 **Standard adoption:** Increased adoption of standardized protocols across platforms. Example: Universal adoption of glTF (graphics library transmission format) 2.0 for 3D models.
 - 2 **Cross-device functionality:** Broader compatibility with a range of devices. Example: Support for VR, AR and mixed reality (MR) devices from multiple manufacturers.
 - 3 **Regular interoperability assessments:** Systematic testing for new hardware and software releases. Example: Monthly cross-platform compatibility testing.
 - 4 **Unified user experience design:** Design guidelines that consider multiple access methods. Example: Consistent user interface elements across desktop, mobile and VR.
 - 5 **Compliance enforcement:** Active engagement in standards compliance and verification. Example: Implementation of a compliance verification process for new releases.
-

Mature (level 3):

- 1 **Advanced standard development:** Leadership in the creation of new universal standards. Example: Contributing to the development of XRSP (extended reality service protocol).
- 2 **Universal device integration:** Full integration support for all major and minor hardware devices. Example: Device-agnostic interfaces that adapt to any hardware.
- 3 **Continuous compatibility monitoring:** Real-time analytics on interoperability status. Example: driven testing and reporting for device-platform interactions driven by AI.
- 4 **Adaptive interface standards:** Dynamic user interfaces (UI) that auto-adjust to the user's device and preferences. Example: Context-aware UI that changes layout and controls for optimal interaction on any device.
- 5 **Standards governance:** Participation in the governance of standards bodies. Example: Holding a seat on the board of a standards organization to influence policy.

Suggested survey questions for maturity assessment

When you switch between different devices to access the metaverse, how smoothly does everything work together?

- A. It's a bit of a hit or miss – not everything works as well as I'd like.
 - B. Generally, things work pretty well across different devices.
 - C. Flawlessly – it doesn't matter what device I use, everything syncs up perfectly.
-

Have you come across any guidelines or rules about how things should be done on the platform?

- A. I've seen some basic guidelines, but they're pretty vague.
 - B. Yes, there are clearer guidelines now, and they seem to be updated once in a while.
 - C. Absolutely, the guidelines are detailed and regularly updated to keep up with new tech.
-

Do you notice any inconsistencies in how the platform looks or behaves across your devices?

- A. Yes, there's quite a bit of inconsistency – it feels like a different experience on each device.
 - B. A little, but it's getting more unified across devices.
 - C. Not at all, the experience is seamlessly consistent no matter how I access the platform.
-

How proactive is the platform in meeting or setting new standards for how things should work?

- A. It seems a bit behind – I don't see them leading the charge.
 - B. It's making efforts and occasionally introduces something innovative.
 - C. It's definitely a leader, often the first to introduce new standards and leading practices.
-

When new technologies are introduced, how well do they integrate with what you already use on the platform?

- A. Integration is patchy – new tech often feels tacked on rather than part of a cohesive system.
- B. Generally, new technologies integrate well, though there might be a few bumps initially.
- C. Integration is seamless – I can start using new technologies right away without any hassle.

Platform compatibility

Emerging (level 1):

- 1 **Basic integration with Web 3.0:** Early exploration of blockchain technologies. Example: Acceptance of cryptocurrency for transactions.
 - 2 **Initial AI use:** Use of AI for basic tasks, like chatbots. Example: AI-powered customer service on metaverse entry points.
 - 3 **Standalone digital wallet use:** Simple wallet applications for managing virtual currency. Example: Proprietary wallet for the platform's native currency.
 - 4 **Ad-hoc blockchain interaction:** Occasional use of blockchain for specific features. Example: Blockchain used for rare item certification.
 - 5 **Limited AI functionality:** AI is used in isolated or non-critical functions. Example: Basic AI non-playable characters (NPCs) in games.
-

Developing (level 2):

- 1 **Digital wallet integration:** Direct support for multiple digital wallets. Example: Platform-compatible wallets that enable direct in-world transactions.
 - 2 **AI for personalization:** AI systems that tailor experiences based on user behaviour. Example: An AI-driven content recommendation engine within the platform.
 - 3 **Multifunctional wallet applications:** Wallets that support both currency and identity features. Example: Wallets with built-in know-your-customer (KYC) verification for identity confirmation.
 - 4 **Systematic blockchain integration:** A key component in the digital economy. Example: Use of blockchain for all digital asset transactions and ownership tracking.
 - 5 **Integrated AI services:** AI functionalities that support critical operations. Example: AI moderation systems for virtual events.
-

Mature (level 3):

- 1 **Blockchain interoperability:** Seamless asset transfer across blockchain platforms. Example: Cross-chain non-fungible token (NFT) use in different metaverse spaces.
- 2 **AI-driven ecosystem management:** Advanced AI algorithms governing interactions and transactions. Example: AI arbitrators for smart contract disputes.
- 3 **Universal digital identity and wallet:** A single wallet that is recognized and usable across all metaverse platforms. Example: A unified wallet that holds digital assets, currency and serves as proof of identity.
- 4 **Decentralized economy infrastructure:** Complete reliance on blockchain for metaverse economy. Example: A decentralized autonomous organization (DAO) managing platform governance.
- 5 **Self-learning AI networks:** AI that evolves based on user interaction and feedback. Example: Adaptive AI that manages in-world ecosystems autonomously.

Suggested survey questions for maturity assessment

How easy it is for you to use features like digital wallets or AI assistants across the platform?

- A. It feels basic and somewhat limited in functionality.
 - B. It's improving, with more options and smoother functionality becoming available.
 - C. It's incredibly easy and intuitive – everything works together flawlessly.
-

How seamless is the incorporation of AI tools or blockchain elements into your overall user experience?

- A. They appear somewhat isolated from the rest of my experience, lacking full integration.
 - B. They are increasingly incorporated, augmenting the depth of the platform.
 - C. They are fully ingrained within the platform, enhancing every aspect of my interaction.
-

Across different activities like hanging out, gaming or working, how consistent is the platform's performance across your devices?

- A. It varies – some activities and devices work better than others.
 - B. Pretty consistent, with a good experience across most activities and devices.
 - C. Perfectly consistent, offering a top-notch experience no matter the activity or device.
-

How cutting-edge does the platform's use of technologies like blockchain and AI seem to you?

- A. It feels a bit behind – I'm not seeing much that's new or exciting.
 - B. They're on the ball, regularly introducing current tech.
 - C. They're pioneers, always a step ahead with the latest and greatest in technology.
-

For managing digital assets and identities, how well does the platform work with different blockchain environments?

- A. It's somewhat clunky and limited to specific blockchain environments.
- B. There's good support for a range of environments, making things easier.
- C. It's outstanding – I can seamlessly move assets and maintain my identity across any blockchain.

Data and identity portability

Emerging (level 1):

- 1 **Manual data transfer:** Moving user data via manual intervention. Example: Customer service-assisted data porting.
 - 2 **Basic KYC process:** Simple identity verification process. Example: Uploading a government-issued ID for account creation.
 - 3 **Awareness of data regulations:** Basic knowledge of global data protection laws. Example: General Data Protection Regulation (GDPR) compliance for European users.
 - 4 **Initial virtual identity creation:** Creating a basic digital avatar. Example: Selecting pre-set avatar features in a single platform.
 - 5 **Data export options:** The provision of some form of data exportability by platforms. Example: Downloading a user data report in comma-separated values (CSV) format.
-

Developing (level 2):

- 1 **Automated data migration tools:** Tools to assist users in transferring data between platforms. Example: A cloud-based service that migrates user profiles with minimal downtime.
 - 2 **Integrated KYC across platforms:** Unified KYC process that works on multiple platforms. Example: A single KYC check valid for multiple metaverse networks.
 - 3 **Regional data portability compliance:** Data transfer mechanisms that comply with specific regional laws. Example: Data residency solutions for platforms operating in multiple regions.
 - 4 **Portable virtual identities:** Avatars that maintain continuity across different experiences. Example: A consistent digital persona that can travel and adapt to various metaverse settings.
 - 5 **Cross-platform data synchronization:** Real-time data sync across platforms. Example: Continuous background data sync for a user's virtual assets.
-

Mature (level 3):

- 1 **Seamless data and identity flow:** Instantaneous transfer of user data and identity between environments. Example: Blockchain-backed identity verification enabling instant access across platforms.
- 2 **Universal KYC standard:** A global KYC system that is accepted by all platforms. Example: A decentralized identity system with a one-time KYC process.
- 3 **Adaptive global data compliance:** Data policies that automatically adjust to international regulations. Example: Real-time data governance AI that ensures compliance with changing global data protection laws.
- 4 **Persistent virtual identity systems:** Identities that retain experiences, reputation and assets across the metaverse. Example: A reputation system that tracks user actions and influences interactions on all platforms.
- 5 **Data fluidity and autonomy:** Full user control over where and how personal data is used. Example: A user-controlled data vault that interfaces with any metaverse platform on-demand.

Suggested survey questions for maturity assessment

If you wanted to move your profile or data to another part of the metaverse, how easy is that to do?

- A. It's pretty cumbersome – I usually need to ask for help or figure it out myself.
 - B. It's getting easier, with some tools available to help me move things over.
 - C. It's a breeze – I can move my data effortlessly with just a few clicks.
-

How protected do you feel your personal information is when you move it around or use different services within the metaverse?

- A. I'm cautious and only share the minimum because I'm not sure how secure it is.
 - B. Fairly secure, but I'm always on the lookout for how my data is handled.
 - C. Completely secure – I trust the platform to protect my data wherever it goes.
-

When you join different areas or activities within the metaverse, how consistent is your identity across these experiences?

- A. It varies a lot – I often feel like I have to start over with each new area or activity.
 - B. There's some level of consistency, but I wish it felt more like a single, continuous identity.
 - C. My identity and experiences are perfectly consistent no matter where I go or what I do.
-

Regarding the control and privacy of your data within the metaverse, how informed and empowered do you feel?

- A. Not very – it's hard to know exactly what control I have over my data.
 - B. Somewhat informed – I've seen some information, but it could be clearer and more detailed.
 - C. Very empowered – I'm well-informed about my rights and how to control my personal data.
-

How smooth is the process if you decide to take your data out of the platform or use it elsewhere?

- A. It's quite a hassle – I'm not sure where to start or if it's even fully possible.
- B. It's doable – there are some processes in place, but they could be streamlined.
- C. It's very straightforward – I can easily take my data wherever I want, no strings attached.

API integration

Emerging (level 1):

- 1 **Basic API offerings:** Limited set of APIs for specific functionalities. Example: An API for retrieving user statistics from a single platform.
 - 2 **API documentation availability:** Documentation exists but may be incomplete. Example: Basic README files for API endpoints.
 - 3 **Third-party API connections:** Initial attempts to connect with external APIs. Example: Using social media login APIs for user authentication.
 - 4 **API security protocols:** Basic security measures for API interactions. Example: API key authentication for access control.
 - 5 **API use monitoring:** Simple logging of API calls for review. Example: Manual inspection of logs for usage patterns.
-

Developing (level 2):

- 1 **Enhanced API libraries:** Comprehensive APIs that allow more complex interactions. Example: APIs that enable the creation and manipulation of virtual objects across platforms.
 - 2 **Standardized API documentation:** Well-documented APIs with clear versioning and changelogs. Example: Interactive API documentation with live testing features.
 - 3 **API integration platforms:** Use of API management platforms to orchestrate services. Example: A platform that manages API calls between in-house and third-party services.
 - 4 **Advanced API security measures:** Enhanced security with measures like [OAuth 2.0](#) and token refresh. Example: End-to-end encryption for data transfers via APIs.
 - 5 **Comprehensive API analytics:** In-depth monitoring and analytics of API usage. Example: Dashboard with real-time metrics on API performance and usage.
-

Mature (level 3):

- 1 **Unified API ecosystems:** A single, extensive API framework used by all metaverse platforms. Example: An API that allows for cross-platform gameplay and asset management.
- 2 **Real-time API documentation updates:** Automated, up-to-date API documentation that evolves with the system. Example: A documentation portal that updates instantly with API changes, including code samples and use cases.
- 3 **API gateway and microservices:** An API gateway that routes all platform interactions, backed by a microservice architecture. Example: A dynamic routing system that scales with the number of users and services.
- 4 **Predictive API security models:** Advanced security powered by AI to predict and mitigate risks. Example: AI-driven anomaly detection to preemptively block malicious API traffic.
- 5 **Proactive API optimization:** Continuous, automated optimization of APIs based on usage patterns. Example: Machine learning algorithms that adjust API throughput and scalability in real time.

Suggested survey questions for maturity assessment

When using apps or services within the metaverse that rely on different APIs, how seamless is your experience?

- A. It feels a bit disjointed; not all apps or services work well together.
 - B. Generally good; most apps and services integrate well, though there are occasional hiccups.
 - C. Completely seamless; I can switch between apps and services effortlessly, with everything working in harmony.
-

How accessible and user-friendly do you find the documentation or help resources when trying to connect different services or apps?

- A. It's pretty limited and often leaves me with more questions than answers.
 - B. It's fairly comprehensive; I can usually find what I need, though it sometimes takes a bit of digging.
 - C. It's excellent; resources are easy to find, well-organized, and very helpful.
-

Can you describe your experience with integrating third-party services through APIs on the platform?

- A. I've tried, but it's been hit or miss; not everything connects as smoothly as I'd like.
 - B. Yes, and while it mostly works, there's room for improvement in making connections smoother.
 - C. Yes, and it's been a great experience; everything connects perfectly and adds value to my metaverse experience.
-

Regarding security, how confident are you in the safety of your data when using APIs to link different parts of the metaverse or external apps?

- A. Somewhat wary; I'm not fully convinced my data is secure when connecting different services.
 - B. Fairly confident; there seem to be good security measures in place, though I stay cautious.
 - C. Very confident; I trust the platform's security protocols to keep my data safe across all connections.
-

How effective do you find the platform's system for monitoring and managing your use of different APIs? Is there a clear oversight on what's being accessed and how it's being used?

- A. There's minimal visibility; I often feel in the dark about what's being accessed.
- B. It's decent; I can get some insights into my API use, but it could be more detailed.
- C. It's very transparent; I have clear insights into my API use and full control over my data and how it's shared.

5

Accessibility dimension

Definition

This dimension focuses on ensuring that the metaverse is inclusive and accessible to users of diverse abilities, promoting equal participation and engagement.

TABLE 9 Key attributes and definitions

Key attributes	Definitions
Access to software	Assesses software’s availability and user-friendliness in the metaverse. Initially limited and unreliable, accessibility is progressing, enabling widespread, affordable and reliable software that supports diverse immersive experiences. A focus on inclusivity and global reach is a crucial part of this shift.
Network and community	Assesses the development of metaverse networks from fragmented, exclusive groups to vibrant, inclusive communities. It highlights the journey towards creating meaningful connections, diversity and collaborative environments where users from all backgrounds can thrive.
Awareness and education	Assesses the progression of metaverse knowledge from niche and misunderstood concepts to broad, accurate understanding and acceptance. It underscores the shift from minimal, inaccurate information to comprehensive education that empowers users across various demographics.
Inclusive and adaptive user experience	Examines the possibility of creating an inclusive metaverse through universal design, multilingual support, adaptive technologies and enhanced usability. This would enable an accessible and equitable experience for all users, regardless of ability or linguistic background. It would also simplify interaction and promote full engagement by addressing diverse needs and removing barriers to participation.

TABLE 10 Maturity levels

Maturity levels	Definitions
Emerging (level 1)	An organization is just beginning to understand the importance of responsible technology. They may have started initiatives, but these are often ad-hoc and not yet embedded in the organization’s culture or processes.
Developing (level 2)	An organization has made a commitment to responsible technology and has started to implement policies and procedures. However, these efforts may not be fully integrated across the organization, and there may still be areas where the organization falls short.
Mature (level 3)	An organization has fully integrated responsible technology into its culture and operations. They have clear policies and procedures in place, and all employees understand their roles and responsibilities. The organization continually monitors and improves its practices to ensure they remain effective and up-to-date.

5.1 Key attribute evaluation criteria

Inclusive and adaptive user experience

Emerging (level 1):

- 1 Basic accessibility features are implemented, such as text-to-speech for key content.
 - 2 Core content is available in multiple major languages (e.g. English, Spanish, Mandarin).
 - 3 Basic adaptive technologies (like screen readers or simple voice commands) are supported.
 - 4 Basic navigation is simplified with clear, large buttons and minimal steps to perform actions.
 - 5 Basic feedback tools are available for users to report accessibility issues.
-

Developing (level 2):

- 1 Intermediate accessibility features are available, including customizable avatars that can represent a range of physical disabilities.
 - 2 Content and support services are offered in a wider range of languages, including less commonly spoken languages.
 - 3 More sophisticated adaptive technologies are integrated, including VR adjustments for users with motion sensitivity.
 - 4 Enhanced navigation options are available, including voice-guided menus and gesture controls for a broader range of interactions.
 - 5 Users are actively engaged through accessibility improvements with regular feedback loops and updates based on user input.
-

Mature (level 3):

- 1 Advanced universal design principles are fully integrated, allowing seamless access for all abilities, with features like 3D environments that are fully navigable via multiple input methods (voice, gesture, etc.).
- 2 Full linguistic inclusivity is offered through real-time, interactive language translation services, diverse language options and other features.
- 3 Cutting-edge adaptive technologies – such as AI interfaces that adapt to user behaviour and abilities – are available and customizable to individual user needs.
- 4 Fully adaptive interfaces that learn from user interactions are incorporated, providing personalized usability optimizations and predictive assistance.
- 5 A community-driven development approach (where users with disabilities can co-create accessibility features supported by advanced analytics to continually refine user experience) is implemented.

Suggested survey questions for maturity assessment:

When you use the metaverse, how easy is it for you to read or listen to content?

- A. I can get the gist of it, but it could be clearer or more audible.
 - B. It's pretty good – I can customize some settings to my liking.
 - C. It's excellent – I can easily adjust settings to perfectly fit my needs.
-

Are the instructions and content available in a language you understand well?

- A. They're mostly in major languages – I sometimes struggle.
 - B. Yes, they're in several languages, though I wish there were more options.
 - C. Absolutely, I can get content in any language, even less common ones.
-

How well do the platform's tools work for you, considering any personal accessibility needs?

- A. Basic tools are there, but not everything I need.
 - B. There's a good range, but I'm looking forward to more improvements.
 - C. I have all the advanced tools I need, and they work great for me.
-

How easy is it for you to navigate the metaverse and do what you want to do?

- A. I can do basic navigation but sometimes hit roadblocks.
 - B. Navigation is easier with some enhanced controls and guides.
 - C. I can move around effortlessly, using various methods like voice commands or gestures.
-

If you've ever had a problem with accessibility, how easy was it to let the platform know and see the changes made?

- A. I can report it, but I'm not sure it leads to changes.
- B. They listen to feedback and seem to make some updates based on it.
- C. Feedback is actively sought, and I often see changes that reflect my suggestions.

Access to software

Emerging (level 1):

- 1 Access to software is limited, expensive or unreliable for most people. Software is often incompatible, outdated or buggy.
 - 2 Most applications are not natively designed for headset use. User experience (UX) and user interface (UI) design for head-mounted displays is still in its infancy, which causes an additional access hurdle.
 - 3 Immersive and interactive experiences are being approached as a new medium by artists and technologists ready to experiment, fail and improve. They are often individual visionaries that had access to information and tools earlier than most people due to their societal or monetary status.
 - 4 The emerging software is mainly used for entertainment, advertising or communication purposes, and does not offer much value or benefit to other domains. The software is, in most cases, not designed with accessibility, inclusivity or diversity in mind.
 - 5 Due to geo-blocking and different local policies of states and countries there is no worldwide distribution of applications. A large percentage of the software at this emerging level may exclude or marginalize users based on their gender, ethnicity, disabilities or location.
-

Developing (level 2):

- 1 Access to software is improving, but still uneven and inconsistent for many people. The software is more compatible, updated and stable.
 - 2 A higher percentage of applications are natively designed for immersion and interactivity, and UI/UX is more accessible.
 - 3 As applications become more relevant, design and development are undertaken by larger groups as well as universities and students.
 - 4 Software is used for a wider range of purposes (such as education, work or socializing), and offers value and benefits for other domains.
 - 5 Due to geo-blocking and different local policies in states and countries, there is no worldwide distribution of applications. There's a focus on designing with accessibility, inclusivity and diversity in mind, but there may still be some gaps or biases that affect some users based on their gender, ethnicity, disability or location.
-

Mature (level 3):

- 1 Access to software is widespread, affordable and reliable for most people. The mature software is highly compatible, advanced and robust.
- 2 A large variety of applications are providing high levels of immersion and interactivity.
- 3 The design and development of immersive applications are simple and approachable for anyone wanting to break into the field.
- 4 The available software is used for a variety of purposes (such as creativity, worldwide collaboration and innovation), and offers significant value and benefit for other domains.
- 5 Due to geo-blocking and different local policies in states and countries, there is no worldwide distribution of applications. The software is well designed with accessibility, inclusivity and diversity in mind, and respects and empowers all users regardless of their gender, ethnicity, disability or location.

Suggested survey questions for maturity assessment

How would you describe your access to the metaverse software?

- A. It's a bit tricky and sometimes expensive.
 - B. Getting better – the software feels more stable and is easier to access.
 - C. No problems at all, it's affordable and works smoothly.
-

Do the metaverse applications you use feel designed for an immersive experience?

- A. They're okay, but I feel like they're just scratching the surface.
 - B. Yes, immersion is getting better, and I'm enjoying the depth.
 - C. Absolutely, the level of immersion is incredible and keeps improving.
-

How inclusive do you find the design and development of metaverse applications?

- A. It feels like it's made for a specific group of people, not everyone.
 - B. There's a noticeable effort to include more perspectives.
 - C. It's very inclusive – anyone can contribute or find something for themselves.
-

For what purposes do you find yourself using metaverse software?

- A. Mainly entertainment or simple communication.
 - B. It's become useful for learning and some work-related tasks.
 - C. I use it for a variety of purposes, including creative projects and global collaboration.
-

Do you encounter barriers like geo-blocking or software not being available in your region?

- A. Yes, quite often.
- B. It's happening less, but still an issue.
- C. Not anymore – I can access what I need from anywhere.

Network and community

Emerging (level 1):

- 1 Networks and communities in the metaverse are local, fragmented or not accessible for most people genuinely interested in the subject.
 - 2 The networks and communities are often limited, disconnected or untrustworthy and do not usually promote meaningful or lasting relationships.
 - 3 The networks and communities are often driven by self-interest, competition or exploitation and do not offer much support or value for new members.
 - 4 The networks and communities are not diverse, inclusive or respectful and may exclude or be unsafe for some users based on their gender, ethnicity, disability or location.
-

Developing (level 2):

- 1 Networks and communities in the metaverse are growing, but are still focused on certain societal groups and selected “hotspot” areas around the world, and seem inaccessible for many people.
 - 2 In the developing stage, communities are more extensive and interconnected, prompting meaningful, lasting relationships.
 - 3 The networks are usually driven by mutual interest, cooperation and equal contribution, and they offer support or value to new members.
 - 4 Due to their tight-knit structure, developing networks and communities are more aware of imbalances in gender, age, ethnicity, disability and location between their members and are actively trying to be diverse, inclusive and respectful.
-

Mature (level 3):

- 1 Metaverse communities and networks are strong, cohesive and vibrant for most people.
- 2 The networks and communities are diverse, connected, trustworthy and independent of the individual's location. They promote collaborative exchange and meaningful, lasting relationships between members.
- 3 Driven by shared interest, collaboration and innovation, people come together to exchange, learn from each other and grow. Applications offer significant support and value.
- 4 Networks and communities are diverse, inclusive and respectful. They protect and empower all users regardless of their gender, ethnicity, disability or location.

Suggested survey questions for maturity assessment

How would you describe your sense of belonging within metaverse communities?

- A. I feel a bit on the outside, it's hard to find my place.
 - B. I'm starting to find communities where I feel more connected.
 - C. I feel a strong sense of belonging and connection in my communities.
-

Do you form meaningful and lasting relationships in the metaverse?

- A. My connections are mostly surface-level.
 - B. Yes, I've started to form more meaningful relationships.
 - C. Absolutely, I have deep and lasting relationships formed in the metaverse.
-

What drives your communities in the metaverse?

- A. It feels a bit competitive or self-serving at times.
 - B. There's a sense of mutual interest and support.
 - C. Shared goals, collaboration and a drive to innovate bring us together.
-

How inclusive and diverse do you find these networks and communities?

- A. There's a lot of room for improvement in diversity and inclusion.
- B. They are making efforts to be more inclusive and diverse.
- C. They're very diverse and inclusive – everyone is welcome and respected.

Awareness and education

Emerging (level 1):

- 1 Awareness and education about the metaverse are not widespread. For most people, existing education is minimal, superficial, inaccurate or unrepresentative of the metaverse's diversity.
 - 2 The metaverse is often misunderstood, misrepresented or ignored by the mainstream media, education systems or public institutions.
 - 3 The metaverse is seen as a niche, frivolous or dangerous phenomenon, and not as a potential source of opportunity, learning and growth.
 - 4 Education about the metaverse is not distributed evenly and publicly in most places and is not inclusive, diverse and equitable.
 - 5 The unequal access to awareness and knowledge about the metaverse is likely to reinforce and perpetuate existing stereotypes, prejudices and inequalities based on gender, ethnicity, disability and location.
-

Developing (level 2):

- 1 Awareness and education on the metaverse are increasing, but still incomplete or unevenly distributed across the world and therefore not accessible for many people.
 - 2 The metaverse is more recognized, discussed and reported on by mainstream media, education systems and public institutions, but most of the population does not have access to the technology or knowledge of how to use it in a beneficial way.
 - 3 The metaverse is generally seen as relevant, interesting and financially beneficial, as well as a possible source of opportunity, learning and growth.
 - 4 Awareness and education on the metaverse are somewhat inclusive, diverse, and equitable, but there are still gaps and challenges that affect some groups based on gender, ethnicity, disability or location.
-

Mature (level 3):

- 1 Awareness and education about the metaverse are widespread, comprehensive and accurate for most people.
- 2 The metaverse is widely understood, represented or embraced by the general population, mainstream media, education systems and public institutions.
- 3 The metaverse is seen as transformative, inspiring and empowering, and as a definite source of opportunity, learning and growth for individuals, businesses, universities and states.
- 4 Awareness and education on the metaverse are inclusive, diverse and equitable, and celebrate and support all groups regardless of their gender, ethnicity, disability or location.

Suggested survey questions for maturity assessment

How informed do you feel about what the metaverse is and what you can do within it?

- A. I have a basic understanding, but it feels like there's a lot more to learn.
 - B. I'm getting a clearer picture, with more resources available now than before.
 - C. I feel very well-informed, with comprehensive knowledge about its vast possibilities.
-

How do you perceive the metaverse's portrayal in media and education?

- A. It's often seen as a niche or not taken seriously.
 - B. Recognition is growing, but it's not fully understood by the general public yet.
 - C. It's widely acknowledged as an important and transformative space.
-

What's your view on the metaverse as a tool for opportunity and growth?

- A. I'm sceptical – it seems more like a trend than a real opportunity.
 - B. I see potential, especially as more educational and professional opportunities emerge.
 - C. I believe it's a powerful tool for creativity, learning and innovation.
-

How accessible do you find education and resources about navigating and maximizing your experience in the metaverse?

- A. Information is hard to come by or overly simplistic.
 - B. It's becoming more accessible, though still somewhat uneven.
 - C. Education and resources are widely available and highly informative.
-

Do you feel that awareness about the metaverse is inclusive and equitable, and considers different backgrounds and locations?

- A. Not really, it seems quite limited to certain regions or demographics.
- B. It's improving, with efforts to reach a broader audience.
- C. Yes, awareness and educational initiatives are highly inclusive, respecting and empowering diverse global perspectives.

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