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DEFINING VIRTUAL WORLDS: MAIN FEATURES AND REGULATORY CHALLENGES

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TABLE OF CONTENTS

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ABSTRACT

This issue paper pursues three goals. First, it aims to identify a definition of virtual worlds that is shared among stakeholders. There are many possible ways to define virtual worlds and the metaverse that differ sensibly depending on the sector, the use case at hand, or the sensibility of those employing the terms. The European Commission (EC)'s call for evidence for a non-legislative initiative on virtual worlds (April 2023)[1] has made things even more complicated. While it employs the term 'metaverse' abundantly in its advertising campaign (website, social media, and so on), it uses only 'virtual words' in the text of the call itself. Clarifying the boundaries of the two notions is thus necessary, to both making sure we all debate over the same subject matter, and for policy makers to target policy intervention at the appropriate issues. This part concludes by providing a definition of virtual worlds.

Second, on the basis of the definitions settled in the first part, this paper identifies the main characteristics of virtual worlds, and highlights a set of challenging features that are relevant for the debate. And third, based on the identified challenging features, the paper raises a set of questions aimed at identifying possible regulatory gaps or topics that might require attention by policy makers.

[1] European Commission (EC), Call for evidence for a non-legislative initiative on virtual worlds, Ref. ARES (2023)2474961 of 5 April 2023, available at https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13757-Virtual-worlds-metaverses-a-vision-for-openness-safety-and-respect_en.

1. METHODOLOGY

The paper builds on a literature review and takes into account the replies to a questionnaire that has been administered to CERRE members, as well as additional materials we received from CERRE members. We also gathered some feedback documents that were submitted by stakeholders in the context of the EC's Call for evidence.[2] More feedback documents might be considered for the final report[3].

The paper is structured as follows.

Section 2: **Definition**. We start by comparing two definitions: that of 'virtual worlds' offered by the EC in its call for evidence, and one we elaborated based on our literature review. Out of this comparison, we propose a definition that clarifies the boundaries and characteristics of both concepts. Such definition is also functional to let challenging issues emerge and helps identify possible regulatory gaps or policy needs.

Section 3: **Features and challenging issues**. Based on the literature review and answers to the questionnaires and materials we received from CERRE members, we analyse the most challenging features of virtual worlds. To do so, we consider the most widely employed business models as of now and divide the analysis into four features: user experience, community content creation, infrastructures and technologies, and governance. Each of these features generate distinct economic, legal, and ethical challenges which are consequently separately analysed.

Section 4: **Regulatory gaps and policy issues**. For each of the issues identified in Section 3, we start assessing whether there are any regulatory gaps or needs for policy intervention. Here, reference to the problems identifies by the EC in its call for evidence is made to mark possible discrepancies.

[2] For this issue paper we considered five papers that were attached to the feedback comments, as they provided more complete and structured responses to the call for evidence (compared to the mere comments).

[3] This Issue Paper is part of a larger project on Virtual Worlds. At the conclusion of the project, a Final Report will be released in the coming months.

2. DEFINITION

We start by providing two definitions. The first one is a definition of virtual worlds we elaborated based on a literature review (2.1); the second one is the EC's definition of 'virtual worlds' provided in its Call for evidence (2.2).

2.1 Literature Review of Definitions (Extract)[4]

2.1.1 Early definitions of virtual worlds by official policy papers

The first three definitions of virtual worlds and metaverse to appear in official policy papers were drafted by the European Parliamentary Research Service (EPRS)[5], the U.S. Congressional Research Center (CRC), and the OECD, all in 2022. These documents refer explicitly to the notion of the metaverse and often employ the term as a substitute for virtual worlds. In a policy brief the EPRS describes the metaverse as "an immersive and constant virtual 3D world where people interact by means of an avatar to carry out a wide range of activities. Such activities can range from leisure and gaming to professional and commercial interactions, financial transactions or even health interventions such as surgery".[6] The U.S. CRC refers to it as "an immersive and persistent virtual world where users can communicate and interact with other users and the surrounding environment and engage in social activities, similar to interactions in the physical world".[7] It further indicates possible applications (like entertainment, health, engineering, estate, military, commerce, education, work). The OECD defines virtual worlds and the metaverse (indistinctly) as AI-enabled "immersive environments based on augmented reality (AR), virtual reality (VR), mixed reality (MR) and other extended reality (XR) technologies that enhance the realism of virtual experiences, blurring the lines between the physical and digital worlds".[8]

These early definitions equate the metaverse to virtual worlds and are fairly general. They are mostly concerned with the need to highlight the key characteristics that differentiate virtual worlds' experiences from two-dimensional (2D) online applications, rather than clarifying what characterises virtual worlds. They stress especially the way users interact with virtual worlds' experiences: the EPRS's definition focuses on interaction through an avatar, whereas the U.S. CRC also highlights that interactions can also be 'not real-life interactions' (in the sense that, they only resemble to them). The OECD particularly underlines the technological layer of virtual worlds' experiences, by tying them to all available enabling technologies (captured under the XR label)[9].

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[4] A complete literature review will be included in the final report.

[5] It is worth noting that the document had been drafted by the European Parliamentary Research Service, which is an internal service of the Parliament conducted by civil servants, not by European Parliament policymakers.

[6] T. Madiega, P. Car, M. Niestadt, L. Van de Pol (2022), Metaverse, Opportunities, risks and policy implications, EPRS (European Parliamentary Research Service), PE 733.557, p. 2.

[7] U.S. Congressional Research Service (2022), The Metaverse: Concepts and Issues for Congress, R47224, 26 August https://crsreports.congress.gov/product/pdf/R/R47224, p. 3.

[8] See also OECD (2022), Harnessing the power of AI and emerging technologies Background paper for the CDEP Ministerial meeting, DSTI/CDEP(2022)14/FINAL, 15 November, available at https://one.oecd.org/document/DSTI/CDEP(2022)14/FINAL/en/pdf, p. 7.

[9] On the notion of extended reality see European Commission (2022), Extended reality: opportunities, success stories and challenges (health, education), September, available at the following link https://digital-strategy.ec.europa.eu/en/library/extended-reality-opportunities-success-stories-and-challenges-health-and-education.

By way of first approximation, these early definitions see virtual worlds as a user experience which likely features are:

1. immersivity and three dimensionality (3D);
2. synchronicity (that is, real-time) and persistence.

The central characteristic for all definitions is the blending of real and virtual realities.

In a report published in 2023,[10] the World Economic Forum adds interoperability across networked platforms as a third characteristic of virtual worlds (equated to the metaverse). In this document, the metaverse is defined as "an immersive, *interoperable* and synchronous digital world" (emphasis added). Interoperability is meant to enable "data to circulate via interoperable infrastructure, of participants to move themselves, their assets and creations across platforms and experiences".[11] The U.S. CRS also considers interoperability a central feature of the metaverse.[12] However, the elements of interconnection and interoperability seem to be associated to a more mature stage of development of virtual worlds and the metaverse, rather than being a key characteristic of present virtual worlds.

2.1.2 Definitions in scholarship

Scholarship and specialised literature instead, provide definitions that are more forward-looking and intersect with the debate over the future of internet (so called internet 4.0). The literature speaks mainly of the metaverse and sees virtual worlds as building blocks for the metaverse which, in turn, is composed of interconnected virtual worlds.[13] The type of virtual worlds scholarship has in mind is therefore associated to a more mature stage of development of technology that will likely be achieved in the medium-long term.

For instance, Matthew Ball describes the metaverse as "A massively scaled and interoperable network of real-time rendered 3D virtual worlds that can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data, such as identity, history, entitlements, objects, communications, and payments."[14] Others refer to the metaverse as "the moment in which our digital lives – our online identities, experiences, relationships, and assets – become more meaningful to us than our physical ones. This perspective puts the focus on the human experience, making the transition to the metaverse a sociological shift instead of, or in addition to, a technological one".[15]

Another relevant feature is that of Mass Content Creation: the metaverse is "populated by 'content' and 'experiences' created and operated by an incredibly wide range of contributors";[16] this happens

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[10] World Economic Forum WEF (2023), Interoperability in the Metaverse, January, available at https://www3.weforum.org/docs/WEF_Interoperability_in_the_Metaverse.pdf. The report is part of the "Defining and building the metaverse initiative" launched by the WEF in May 2022.
[11] Ibid., at 3.
[12] U.S. CRS, above nt 7, at. 4.
[13] L. Floridi (2022), Metaverse. A matter of eXperience, available at: https://ssrn.com/abstract=4121411 (noting that "just as there is the Web and there are websites, there is the Metaverse and the 'metaverse sites'").
[14] M. Ball (2022), The Metaverse: And How it Will Revolutionize Everything, WW Norton.
[15] M. Baier-Lentz (2022), Three technologies that will shape the future of the metaverse – and the human experience World Economic Forum, available at the following link https://www.weforum.org/agenda/2022/02/future-of-the-metaverse-vr-ar-and-brain-computer.
[16] M. Ball (2020) The Metaverse: What it is, Where to Find it, and Who Will Build it, 13 January, available at: https://www.matthewball.vc/all/themetaverse.

thanks to the "impressive amount of editing capabilities and augmented reality options for users to create content with".[17]The blockchain already allowed users to create NFTs on a distributed decentralised manner; with easily manageable generative AI tools, content creation is popularised to mass scale.

Mass Content Creation will have a crucial role in the economics of virtual worlds: it will empower users, enabling them to shape their own virtual and immersive experiences, thus increasing their engagement. In addition, mass content creation will enhance the attractiveness of virtual worlds - alongside services and goods provided by professional operators - populated by new assets and services generated by the users themselves.[18]

These later definitions incorporate three elements: a technological-business one (plurality of interconnected virtual worlds), the user experience component (like earlier definitions) and Mass Content Creation. This is noteworthy because a workable notion of virtual worlds should also take into consideration the different hardware and software components, as well as the content generated by its users.

Therefore, existing virtual worlds are use cases that provide excellent information for a deeper understanding of the future of virtual worlds, and help to shed light on the different interfaces, environments, technology, types of interaction among users, and market dynamics.[19]

We should acknowledge that more far-reaching definitions exist. For instance, Damar describes the metaverse as "the layer between you and reality" and refers to it as a "3D virtual shared world where all activities can be carried out with the help of augmented and virtual reality services"[20]. Clearly, this definition has in mind a mature, fully-realised environment (that the author calls metaverse) which would coincide with or englobe the web (the web 4.0). While this might be a possibility in the long run (experts speak of a 10-15-year timespan), the very idea of metaverse has recently lost some of its grip in the business community.[21] Nonetheless, investments in technologies aimed at its full deployment are ongoing (for instance, generative AI for content creation, visors minimisation, and more).

Hence, based on literature review, we can distinguish three phases of development of virtual worlds culminating in the web 4.0 type of Metaverse:

[17] J.M. Garon (2022), Legal Implications of a Ubiquitous Metaverse and a Web3 Future, available at: https://ssrn.com/abstract=4002551 or http://dx.doi.org/10.2139/ssrn.4002551; see also M. Lewczyk, Snapchat Commits to the Metaverse With Launch of 3D Bitmojis, Virtual Humans, 28 July 2021, available at: https://www.virtualhumans.org/article/snapchat-commits-to-the-metaverse-with-launch-of-3d-bitmojis

[18] World Economic Forum, WEF, Demystifying the consumer metaverse, January 2023, p. 43. See also Cominted Labs, How AI Will Revolutionize Metaverse Content Creation, available at https://comintedlabs.io/how-ai-will-revolutionize-metaverse-content-creation/.

[19] S.M. Park, Y.G. Kim (2022) A Metaverse: Taxonomy, components, applications, and open challenges. Ieee Access, 10, pp. 4209-4251.

[20] M. Damar (2021) Metaverse shape of your life for future: A bibliometric snapshot, in Journal of Metaverse, 1 (1), pp. 1-8.

[21] See below section 3.5 on skepticism.

Table 1: Phases of development of virtual worlds

	BIRTH	INFANCY	MATURITY
TIMESPAN	Nowadays	Mid run	Long run
DEGREE OF INTERCONNECTION AND INTEROPERABILITY	Siloed virtual worlds	Interconnection/ interoperability of virtual worlds	Interconnected virtual worlds within one environment that coincides with the web
EMPLOYED TERMINOLOGY	Virtual worlds	Virtual worlds	Metaverse

2.1.3 Definition of virtual worlds and their characters

In light of the above literature review, we propose the following definition of virtual worlds:

"***An immersive, synchronous, persistent and unified 3D user experience that might enable mass content creation***".

We deem this definition comprehensive and not-too-far-reaching at once. While capturing the main characteristics of virtual worlds identified by earlier definitions, it does include features that have already landed on the market or are foreseeable, like Mass Content Creation. This definition covers the first two phases of virtual worlds, comprising their birth (current stage) and infancy (more mature, intermediate stage), but not the last one (fully-realised metaverse) (see Table 1 above).

As a caveat, we need to clarify that virtual worlds and virtual reality are two different concepts: the first one refers to the whole user experience, while the second is one of the enabling technologies for the user experience.

In the following, we describe each characteristic of virtual worlds contained in the scholarship's definition.

A. Immersivity

It refers to the type of experience that virtual worlds enable and is composed of: in-web presence, indicating the idea that virtual worlds may enable experiences not "in front of the web" but "within the web", and sensoriality. More specifically, in-web presence refers to a 'fictitious representation' on the Web of a person, business, or some other entity that allows them to locate and interact. In AR/MR contexts, fictitious representation refers mainly to objects (that are digitised), while in VR environments it encompasses also persons and companies, making immersivity deeper. Sensoriality indicates a surrounding experience that encompasses all senses – or many of them.

In general, different enabling technologies allow for different levels of immersivity: for instance, immersivity granted by AR is lower compared to VR. Because virtual worlds are defined as user experiences, the degrees of immersivity can be tailored to the users themselves. In fact, not all users have the same goals when engaging in virtual worlds: some might need only little, while others require full immersivity. In gaming, for example, there are users who may want to perform activities that can also be carried out by means of a mobile phone (which enables a lower level of immersivity). The PokemonGo case illustrates well the point: the app featured the option to be used both with MR and AR.

B. Synchronicity

It refers to the ability of virtual environments to allow users to communicate and interact in real time, or in ways that make them feel as if they were actually in a common environment; for instance, in medical rehabilitation, patients experience greater proximity with their care givers. Different devices and technologies allow for diversified degrees of synchronicity.

C. Persistence

It indicates that virtual worlds continue to evolve even when users are not connected to them, and the consequences of such evolution are perceived by/affect the user when connected again. Special connectivity features are needed to allow persistence of virtual worlds. Persistence (like immersivity) also varies depending on the technology employed. Virtual worlds enabled by AR, for example, have a lower degree of persistence compared to other technologies while still maintaining the characteristic. Think for instance of IoT's metadata that are exchanged when a user interacts with reality using her AR device (smart glasses exchanging metadata on the temperature of a pot when approaching sensors located in the kitchen for instance): in this case, (digital) information about the heat changes overtime even when the user is not connected.

Similarly, when AR is employed to help cultural heritage restorers perform their job by letting them visualise the deterioration of an ancient artefact, information regarding the degradation of the object continues to update (due to some atmospheric agent) even when the restorer is not connected. In sum, even when the user is disconnected, both the physical world and objects linked to it can evolve and change.

In the case of VR, the degree of persistence is highest, as other users also interact with and can therefore modify the (virtual) reality and impact the user's sphere, even when disconnected. The main difference with AR experiences is that while in VR the user might be impacted directly from changes in the environment that took place while off-line and without having any control on that, in AR experiences the user keeps a degree of control and can selectively and consciously decide to engage in a certain experience.

Persistence exists in MR as well. Taking the example of restorers mentioned above, one can think of several collaborators working on a broken statue restoration, with 3D-holograms featuring the statue's missing parts, built based on historical research. Not only the physical object, but also the hologram can change over time, due to new discoveries and progress in historical research, and the way reconstruction work is advancing.

Thus, entering the museum on a given day, a user can see the statue with only one missing part (an arm, for instance) digitally reconstructed; while, at a later time, other parts could also be reconstructed.

D. Unity

It refers to the quality of a plurality of virtual worlds that are interconnected and interoperable among them, a condition that does not exist in the present phase (Birth in Table 1, above), but will materialise at a more mature stage of development (Infancy). Once virtual worlds are unified (that is, interconnected) and the technologies upon which they are based are made interoperable, users will be allowed to move their identities, data, and items seamlessly from one to another. One should caution, however, that in the Birth phase, pursuing interoperability in full (that is for all software and hardware, and at all levels), should be carefully evaluated and tradeoffs assessed (for instance, impact on investments). Nonetheless, even at this stage, some interconnection and interoperability, similar to what happened on the internet,[22] would be advisable.

E. Three-dimensionality

It means that the user experience occurs within computer-simulated electronic 3D virtual environments (in the case of VR) or through the interaction with computer-simulated electronic 3D virtual elements (in AR and MR). This characteristic is strictly connected to the “in web presence” feature of virtual worlds described above (2.1.3.A).

F. Mass content production

Users are enabled to create content (for instance, through generative AI, or NFTs minting programs), or apps to add and new features to virtual worlds. This way they may modify the environment in which they enjoy the services: as of yet within one virtual world and, in the future, also across virtual worlds. In VR-enabled environments, the mere fact of existing in the virtual world entails the creation of content (the avatar).

2.2 The EC’s Definition (Call for evidence 2023)

We now illustrate EC’s definition of virtual worlds and analyse its components.

The EC affirms that virtual worlds “offer real-time, immersive and persistent environments that blend physical and virtual realities in many different areas like medicine, manufacturing or smart cities”. It then adds that “Virtual worlds are also part of a wider, longer-term technological change: a transition towards Web 4.0 where physical and digital worlds will enable more intuitive and immersive experiences and smart devices will seamlessly communicate to perform complex tasks.” (p. 1)

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[22] U.S. CRS, above ft. 5, at. 5; with reference to technological aspects of the interconnection on the internet see L. Rosston, D. Waterman (1998), Interconnection and the Internet, Selected Papers From the 1996 Telecommunications Policy Research Conference.

Preliminarily, we should note that the EC seems skeptical to use the term metaverse: while it is prominently employed as a substitute for virtual worlds in the call for evidence's webpage (that is titled "*Virtual worlds (metaverses) – a vision for openness, safety and respect)*"), it does not appear once in the text of the call itself.[23] That might be due to the fully understandable need not to evoke any specific business or to the notion that the metaverse itself is not a fully settled concept among stakeholders.

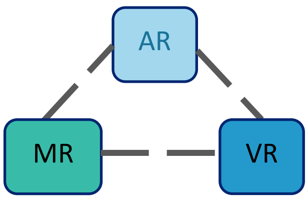
Be as it may, the definition laid down by the EC does not differentiate between the two concepts. Rather, our understanding of it is that it refers to two different stages of maturity of virtual worlds: Birth and Infancy, respectively (Table 1). The first part of the definition refers to today's' virtual worlds and 3D experiences (Birth); whereas the second part discusses Web 4.0 scenario and the internet of the future, and suggests that at a more mature stage, virtual worlds would most likely appear as a fully integrated environment (as our proposed definition suggests), the access to which is permitted by "devices" that will communicate "seamlessly". This would coincide with the Infancy phase in Table 1.

2.3 Comparison of Definitions

Having laid out the two definitions, we now compare the two to clarify the subject matter we are discussing and with the purpose of coming up with a definition that may be widely agreed upon.

The EC considers the "metaverse" and "virtual worlds" as synonymous, given that the latter are "real-time, immersive and persistent environments that blend physical and virtual realities" (first part of EC's definition). Virtual worlds are siloed, and each allows for a given type of user experience, enjoying different degrees of immersivity, synchronicity, and persistence depending on the technologies they are enabled by. The latter are selected based on the type of service or experience users may wish to have. State of the art enabling technologies include AR, VR and MR, but not necessarily emerging ones (such as neural technologies). (Fig. 1).

Fig. 1: Virtual worlds at Birth stage - first part of EC's definition

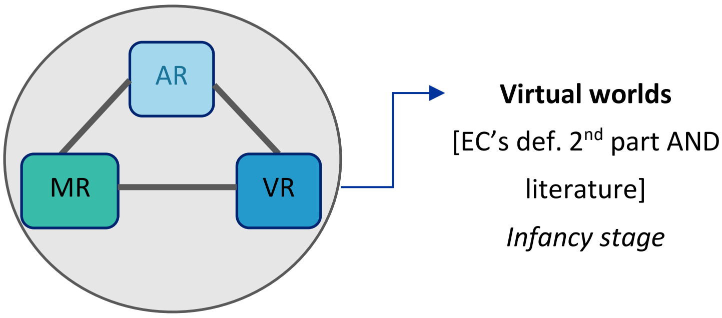


Virtual worlds
[EC's def. 1st part]
Birth stage

In contrast, the definition of virtual worlds/metaverse resorting from the literature review depicts a broader concept that incorporates present virtual worlds (Birth) in one unified space (Infancy). While the EC's definition focuses on 'environments', the literature review's is more 'user-centric', focusing on the user experience (UX). However, both convene that virtual worlds should be immersive, synchronous and persistent.

[23] See: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13757-Virtual-worlds-metaverses-a-vision-for-openness-safety-and-respect_en

Fig. 2: Virtual worlds at Infancy stage – second part of EC's definition and literature review



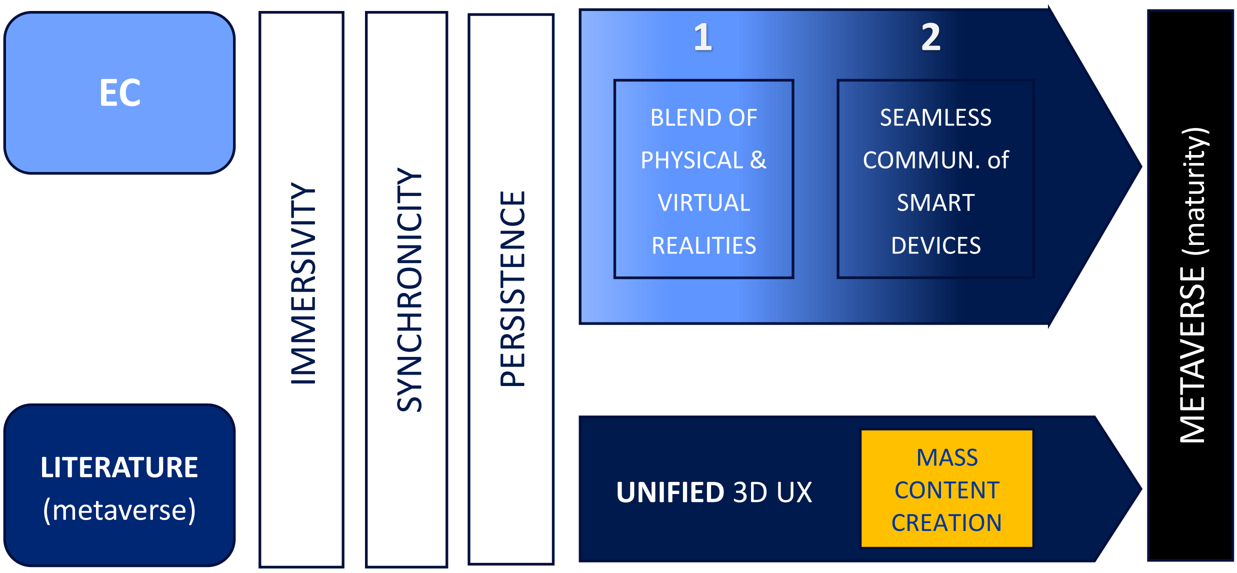
As anticipated, however, the second part of EC's definition ("physical and digital worlds will enable more intuitive and immersive experiences and smart devices will seamlessly communicate to perform complex tasks") converges towards the literature review's by mentioning seamless communication of smart devices (Infancy).

'Seamless communication' might be understood as the ability to communicate within one virtual world (between avatars or users, for example) without interruptions or delays, similar to communication in the real world. If this interpretation is correct, then seamless communication of devices only refers to the capacity of devices to facilitate interaction and ensure greater immersivity of user experience in virtual worlds, without the need for different devices to interconnect.

However, because 'seamless communication' is mentioned in reference to smart devices (plural: visors, smart glasses, C-BIs, mobiles of the future, IoT sensors, and so on), it appears that the EC has in mind the ability of different smart devices to connect, interact, and exchange data without any interruptions or disruptions (Infancy). This, in turn, may entail shared communication protocols (like the Internet Protocol) and interoperability/compatibility between different brands and types of devices, which would enable automation, control, and the creation of connected experiences: the latter seem to coincide with the ability of "performing complex tasks" included in the second part of EC's definition (Infancy). As discussed below (3.4 and 4.4), however, policy makers should exercise caution when deciding if, how, and when to intervene on this subject matter.

As correctly stated in the EC's definition, fully-materialised virtual worlds require "longer-term technological change". In the long term, thus, technological advancement will allow current virtual worlds to blend. Such blending is understood as a net of interconnected/interoperable virtual worlds, that allows for a unified 3D user experience, that is immersive, persistent and synchronous (because it encompasses several enabling technologies) and might enable mass content creation" (Fig. 3).

Fig. 3: Unpacking and comparing definitions of virtual worlds



To sum up, the definition given by the EC in its first part (which equates virtual worlds to the metaverse) is descriptive of existing virtual worlds (Birth) by considering only those enabled by AR/VR and MR (Fig. 1). By doing so it excludes wider and more complete UXs which can be understood by employing our definition of virtual worlds (Fig. 2) that includes the Birth, but also extends to Infancy state of development of virtual worlds. This would overlap with the second part of the definition given by the EC itself, which widens the definition of virtual worlds making it closer to ours (Infancy). Lastly, by referring to prospective virtual worlds in the Web 4.0, the EC indicates the direction for the future (Maturity), which requires a long-term technological change leading to a fully-materialised metaverse. Maturity stage is however excluded from consideration in this paper.

In light of the above, we deem that the definition of virtual worlds we provided might prove more future-proof than the sole first part of the EC's one, given that it is not merely descriptive of virtual worlds as they actually are, and therefore it should be more fit for policy purposes. For these reasons, we will use the definition of virtual worlds that we have drawn (above, 2.1.3), for the sake of this issue paper.

3. FEATURES OF VIRTUAL WORLDS AND RELATED ISSUES

In the following, we identify a number of distinctive features of virtual worlds that resort from the definition given above. However, those features don't coincide with the individual characteristics of virtual worlds (immersivity, persistence, synchronicity, unity, three-dimensionality, and mass content production). This is because the features we identify and present hereafter, which are based on the literature review, the replies to our questionnaire, and materials received from CERRE members, are cross-cutting and touch upon different layers of virtual worlds' value chain. For instance, immersivity cuts across both user experience (by affecting users' engagement, for instance) and enabling technologies (by impacting different stages of technology deployment, for example).

Consequently, we identify four relevant features of virtual worlds: user experience, mass content creation, technology and connectivity infrastructure, and governance. For each of them we provide an analysis of the relevant issues.

3.1 User Experience

User experience (UX) indicates both the set of activities that users can engage in within virtual worlds as well as the effects that these may have on the user, their preferences, and assets.

The kind of UX deployed in virtual worlds is different from that of other 2D digital spaces. What differentiates the two are primarily synchronicity and three-dimensionality. More than other characteristics, those two raise concerns for the perceived quality of the whole UX and highlight issues that are strictly dependent on the efficiency of the technologies (software and devices) employed.

3.1.1 Attractiveness

Synchronicity of shared experiences is key in making the virtual worlds appealing for users. In virtual worlds users can perform social and collective activities (like receiving health assistance, making in-gaming purchases, or even political participation) feeling as if they were in the same common virtual space. Community building dynamics are thus essential in reinforcing the attractiveness. Enhancing relations through cross-virtual worlds engagement can be done by several means, such as mass generated content or the transferability of assets across the metaverse (see section 3.2.3).

3.1.2 Perceived quality

The perceived quality of the user experience depends much on the attractiveness of virtual worlds and their retention of the user base. Factors that input the perceived quality clearly vary depending on the use case and individual user. Personalisation is thus a key to leverage on the quality perception. Graphic quality of digital content is another factor and should be maintained, where technically feasible, once the token or digital object is moved from one virtual world to another across the metaverse. However, challenges may arise: for instance, if quality has to be maintained, the minimum specification requirement for hardware to join virtual worlds may increase. Games today already employ varying framerates, dynamic resolutions and other technologies to support lower power devices. Something similar could be implemented by each provider to keep engagement rates high within its own virtual world and, where technically feasible, across virtual worlds. Similarly, security, safety and data (both personal and non-personal) as well as digital rights protection are factored in the perceived quality of the UX. As those elements may vary sensibly across virtual worlds, the perceived quality of all virtual worlds may be negatively affected by one single bad experience.

3.1.3 Devices

The user experience in virtual worlds is, at least to date, strongly influenced by the devices available to the user, which represent the entry portal to virtual worlds. There is wide consensus over the idea that virtual worlds may enable experiences not “in front of the web” but “within the web” (that is, in-web presence).[24] It is debated, however, if also computers and mobiles should be considered as enabling devices for virtual worlds. Although these tools can be used as entry points to access virtual worlds, they are in front of the users‘ eyes (as a simplified form of visor), and only suitable for providing a minimal degree of 3D experience to the user. Screen-based devices (like PCs) might also be used for their computational power (For further discussion of these technological aspects see section 3.3 below).

3.1.4 Efficiency vs inclusiveness

Virtual worlds have enormous potential to enhance social inclusion, since they can remove territorial distances for accessing in-person services (consider virtual health labs, for example). When used for educational purposes, virtual worlds can make training more effective, while also improving digital literacy. For instance, in university law classes, legal clinics may be deployed through VR or MR, reaching a higher level of engagement by the students (who will be less anxious in meeting the clients) and less advantaged people (who would feel more comfortable to speak of their legal problems and receive pro bono assistance).

However, the accessibility and inclusiveness of virtual worlds may be affected by different factors. Firstly, connectivity requirements, given latency, may play a large role in rendering 3D worlds in real-time. Secondly, devices come with different prices, sensor suite, and processing power allowing for diverse degrees of immersivity.

Accessibility may be prevented by differing quality of network connection. For instance, two people might not be able to share an experience if one is using AR and the other a 2D screen. Or, more importantly, if the latency between two users is too long, they would not be able to engage in a synchronous experience. Not intervening on these issues may impact on the most remote areas, where virtual worlds may prove essential to enhance public services provision like health.

Inclusiveness may be affected in several ways. On the one end, more sophisticated devices can be unaffordable to many, who will remain excluded to more advanced UX; on the other end, those who want and have the right to disconnect might feel invaded. More generally, high diversity in device-driven UX may generate inequality among users who would have a different (and not equally enjoyable) experience (for instance, in gaming, users entering the metaverse with a less powerful

[24] See above 2.1.3.A.

device allowing for poorer perception and reaction to external stimuli may affect the experience of other users). Therefore, technical product requirements aimed at ensuring a (minimum) acceptable level of UX are likely to emerge.

Thus, because technologies are still at early stage of development, the industry, as part of the usual process of emerging markets, will likely need to work on technical product requirements to ensure interconnection and a (minimum) acceptable level of UX, and do so in a self-regulatory cooperative way (in Standard Setting Organisations - SSOs, for instance).

3.2 Mass Content Creation

Content creation is increasingly moving towards mass production by users (both users and consumers) in combination with cloud computing and generative AI (amongst others it is worth mentioning self-produced NFTs, gamification, apps, digital art and fashion).

Virtual worlds will more and more feature mass-created content economy that will help populate it. It is therefore relevant to assess what makes mass content creation profitable and how to incentivise it.

3.2.1 Technology

There are already several technologies (and further are constantly being developed) that play an enabling role and whose functionalities allow for content creation (NFTs-converted pictures, for instance). Open and cross-device platforms also engage developers and manufacturers – from small to large enterprises – to collaborate in the co-creation and building of immersive apps and new technologies for virtual worlds experiences (such as Snapdragon Spaces™). Advancements in technology and tools available to users, like generative AI, may also improve the ease with which content is generated or how content can reactively adapt to users' inputs. Developers in the market are fully engaged to offer the new hype application that may make new content easy to create for users.

3.2.2 Education

At the same time, digital education has the potential to empower users and enable them to better master content creation. Content creation is, in fact, among the key indicators of digital literacy and is employed as a teaching tool in learning by doing practice.[25.]

3.2.3 Monetisation and other incentives

Allowing monetisation is typically a means to foster user engagement. The same holds with mass content creation. However, according to certain sources, the prevailing scheme for incentivising engagement (that of social networks), which is based on the verticalised 'influencer-follower' model, does not remunerate followers' time and attention, only those of influencers (through ads and

[25] T. Lynde, K. Beaumie (2015) Learning by Doing in the Digital Media Age, available at 10.1007/978-981-287-326-2_12.

resale).[26] In virtual worlds users are also creators and therefore employ their time and attention to ameliorate virtual environments. These efforts could be compensated. Since the pyramidal 'influencer-follower' model is rapidly reaching its peak in popularity, new tools to remunerate engagement that are different from mere 'likes' are needed in addition to monetary incentives (proposals in this regard are made below, 4.2).

3.2.4 Foster seamless movement of items

It follows from the character of a 'unified 3D experience'[27] that mass content creation would be strongly incentivised if users were allowed to move their creations (identities, data, and items) seamlessly. This pursues the dual purpose of employing them within a virtual world (as it happens already) and monetising them by selling to other users in other virtual worlds.

To create a secondary market for virtual goods and identities it is therefore necessary to create user-friendly models for their transfer. Such models should be based on interoperability standards (see 3.3 and 4.4 below).

3.3 Technologies and Connectivity Infrastructures

To make virtual worlds reach their full functionality many different *technologies* are needed. Each of them has specific features that can impact the structure, interconnection among virtual worlds, the ways in which users interact, and – not least – virtual worlds' capacity to express and exploit all their potential characters (outlined in the definition above: immersivity, synchronicity, persistence, 3-dimensionality, mass content production).

Besides technologies, *connectivity* is another essential enabler of virtual worlds. Connectivity for the metaverse may be delivered by several infrastructures, among them: fixed high-speed networks, mobile high-speed networks (including 5G mmWave for dense urban areas, and future 6G), edge computing, or Bluetooth.

Connectivity infrastructures. To enable persistence as well as full (and seamless) mobility between virtual words and the sharing of content among them, their IT infrastructures should be made compatible. To do so, connectivity infrastructures (such as Application Programming Interfaces - APIs) would require some common features. Even if no standardisation initiatives are undertaken, at least certain minimum technological aspects that enable compatibility (with reference to both hardware and software) might be defined. Considering that the EC announced a parallel initiative aimed at studying a performant and resilient infrastructure for connectivity needed for the functioning of virtual worlds,[28] we do not elaborate further on this topic.

[26] T. Di Bartolo (2023), How Phygital Takes The Metaverse Into Mass Adoption, And What That Means For Businesses, February 8 available at the following link https://www.forbes.com/sites/forbesbusinesscouncil/2023/02/08/how-phygital-takes-the-metaverse-into-mass-adoption-and-what-that-means-for-businesses/

[27] See definition above, section 1.3

[28] On February 23rd 2023, the EC presented "new initiatives, laying the ground for the transformation of the connectivity sector in the EU". On the same day, it published the Gigabit Infrastructure Act Proposal (COM(2023) 94 final 2023/0046 (COD)) and Impact Assessment (SWD(2023) 46 final).

Technology. As mentioned,[29] persistence refers to virtual worlds' ability to evolve even when the user is offline and yet the effects of the evolution will produce consequences for the user. Among the many, technologies used in video games as well as network and computation power could be viewed as necessary to facilitate persistent environments and user connection. Similarly, AI, display technologies, and blockchain engineering can be functional to achieve such objectives.

When dealing with blended real-virtual realities (MR hypothesis), persistence requires a bi-directional flow of information that makes the environment evolve continuously, considering both the changes that have taken place in the real world, as well as those specific to virtual worlds or virtual elements that are plugged into the real world.

3.4 Governance

Currently, no clarity exists on the governance structure of virtual worlds: whether there will be a unified borderless virtual place (like nowadays' World Wide Web)[30] (Fig. 2, above) or many different virtual worlds but not connected one to the other (Fig. 1, above).

Due to the different technologies and protocols each virtual world uses, there is no consensus as to whether virtual worlds, at their mature stage, will be based on proprietary standards and centralised governance, or an open decentralised framework will prevail (using blockchain, P2P, and so on).

At present, virtual worlds employing centralised structures (like many social networks) tend to prevent users from contributing to the development of the platform itself. On the other hand, decentralised virtual worlds[31] are community-based environments where users can deploy content creation (above, 3.2) to develop software on a distributed basis. However, as cautioned by Europol, decentralised technologies are being taken up by big tech to support their platforms and centralised services too.[32] It is therefore hard to foresee what governance structure will prevail.

A related, although different issue is that of market power and whether, at their maturity, virtual worlds will be dominated by a handful of big players, or one of its features[33] tipped.[34] The market tipping scenario is taken in utmost consideration by the EC and also reflected in its call for evidence, where the European Commission highlights the "risk of having a small number of big players becoming future gatekeepers of virtual worlds, creating market entry barriers and shutting out EU start-ups and SMEs from this emerging market" (p. 2). In this regard, although it is true that some of the services

[29] Above, 2.1.3.C.

[30] T. Di Bartolo (2023), How Phygital Takes The Metaverse Into Mass Adoption, above under fn. 23 describes Phygital as the most mature phase of the metaverse, where digital and physical realities will overlap: we will no longer use headsets or type an address to navigate it, but simply "where we stand is where the metaverse will be".

[31] Like gaming platforms, decentralized 3D browser-based virtual worlds, and new entrants like innovative start-ups or SMEs

[32] Europol (2022), Policing in the metaverse: what law enforcement needs to know, October, p. 12, available at the following link https://www.europol.europa.eu/publications-events/publications/policing-in-metaverse-what-law-enforcement-needs-to-know.

[33] See above Sect 2. We refer specifically to the following features of virtual worlds: user experience, mass content creation, infrastructure, and technology.

[34] Market tipping occurs when a firm pulls away from its competitors once it gains an initial advantage. The market tips when a winner takes most, if not all, of the market. See N. Petit (2021), The Proposed Digital Markets Act (DMA): A Legal and Policy Review, May 11, available at the following link https://ssrn.com/abstract=3843497.

enabling virtual worlds, like cloud for instance, might be at risk of market power consolidation and thus justify special attention,[35] the same does not necessarily hold for others.

Similarly, because of the large costs involved in the development of virtual worlds, it is not easy to reach tipping scenarios. Rather, what is gradually emerging is a high degree of cooperation, where centralised and decentralised operators are collaborating (more or less openly) on the most innovative portions of virtual worlds'-related technologies and services. This testifies that collaboration is needed to make virtual worlds a success. Such collaboration is especially open and visible among technology developers and can be appreciated at the level of interoperability and standard setting.[36]

This cooperative model will possibly have a direct impact on the timing of virtual worlds' full development as well as its final governance structure. It is not by chance that the EC, again in the Call for evidence document, recalls that it is "Crucial for the EU to be present in the development of virtual worlds and their governance, and lead the way through important challenges such as setting standards". (p. 2)

We will return on the issues of interoperability and standard setting in virtual worlds below (par. 4.4).

[35] Being cloud qualified as a Core Platform Service under the DMA, gatekeeping companies providing such services are already subject to its provisions, as well as antitrust scrutiny.

[36] See e.g. the Metaverse Standards Forum (https://metaverse-standards.org/), counting over 2000 members coming from the industry, SDOs, Universities, institutions, and advocacy organizations (including consumers).

4. REGULATORY GAPS AND POLICY ISSUES

From a policy perspective, a first challenge concerns whether policy-makers should consider an overarching policy that covers all possible use cases/virtual worlds – across both consumer and enterprise segments, or whether policy should be distinct for each user experience showing similar characters. For instance, should virtual worlds in the health sector be tackled through the same policy as entertainment ones? Would a policy aimed at addressing all at once be preferable?

We believe it might be too early to take a final position on this issue given the current stage of development of virtual worlds. For this reason, we deem preferable to focus on the features discussed above (Sect. 3), that are shared by all virtual worlds and to provide, in this last section, a preliminary assessment of the possible regulatory gaps and policy issues related to each of them.

4.1 User Experience

As discussed, cybersecurity, safety, and data (both personal and non-personal) as well as digital rights (including intellectual property rights) protection are essential elements of the perceived quality of the UX (for both users and creators). As those elements may vary sensibly across virtual worlds, there is room for spillover effects (that is the perceived quality of all virtual worlds may be negatively affected by one single bad experience).

As outlined by the EC, the current EU regulatory framework already tackles many of these issues through (among others) the Digital Markets Act (DMA), Digital Services Act (DSA), and the General Data Protection Regulation (GDPR). Other legislative initiatives that seem sufficient to deal with most of the risks highlighted above are also in the pipeline (such as the proposed Artificial Intelligence Act, the Digital Identity framework, and the Data Act). These instruments might cover, for instance, the highly debated issues of how to protect avatars' data and whether they fall under the scope of personal or non-personal data protection frameworks.

On the other hand, there are some issues that might call for specific consideration by policy makers. We only outline some of them below,[37] and will provide greater details in the upcoming Final Report for this project.

4.1.1 Behaviour moderation

The current legal framework tackles illegal and harmful content online (through the DSA, for example). The notion of content refers to products and services, as well as hate speech or fake news. It is not clear, however, whether behavior of people (in MR contexts) or of avatars would fit and be therefore moderated. That might have different impacts on the perceived safety of virtual worlds and thus require special attention.

[37] Other possible concerns are e.g. terms of use, codes of conduct, community guidelines, as well as expectations of users.

4.1.2 Accountability

Meanwhile, it seems appropriate to consider specific accountability of users and service providers for their harmful or illegal conduct, that possibly employs technological tools. Technology may ease the detection of harmful behavior and the respective enforcement. In that sense, one possibility could be to combine technology and robust systems and processes.[38] In that case, technology would need to capture data to attribute actions of users and service providers within the metaverse to support analysis and evidence.

Regulation, on the other hand, would need to ensure that, regardless of specific technologies employed, systems and processes are robust in identifying behavior contravening terms of service, and providing consistent mechanisms for recourse, redress, and where appropriate escalation.

From a legal standpoint, it is difficult to determine what liability scheme would exist that accommodates different virtual worlds, given the variety of technologies they are based on and the absence of legal interoperability. From an economic perspective, plurality of virtual worlds may make transaction costs high: as noted, some user experiences will likely be virtual-real interactions (like medical care), while others will be fully virtual, resulting in differing contractual means to interact. Hence, having appropriate liability and default contracting rules (including certification of expertise) to enable efficient transactions would be desirable.

4.1.3 Jeopardised protection

Rules for detection of harmful behavior and related enforcement can be achieved either by means of binding regulatory initiatives or by virtue of commercial initiatives taken by individual service providers. In the latter case, the terms and conditions will reflect the level of user protection. However, in an interconnected/interoperable virtual worlds scenario, a minimum level of protection common to all virtual worlds could be considered, as spillover effects might arise (that is, the protection provided in a single virtual world would be easily frustrated if not 'transferred' to another across the metaverse).

Again, technology might help in this regard. Specific technological safeguards could be put in place to ensure the full enforcement of liability rules and codes of conducts (for instance, coding directly into the avatars' source-code the detection of certain harmful conducts, so that the avatar would not work – leading also to the cancellation of it in most severe violations). That would prevent regulatory arbitrage based on some virtual worlds' (or countries') more facilitating regimes.

More broadly, moving and interacting across virtual worlds might entail cross-border activity between a person in two different countries, creating jurisdictional frictions (such as which country's law is applicable). Although these problems have already been tackled in the current world wide web, there are more challenges that need to be considered, like 'new products' and 'mixed virtual worlds' products' that go across multiple virtual worlds or between a virtual world and our world (how to grant protection to 'phygital' assets that consist of physical goods that feature also a digital extension,

[38] Proposal made by one of the respondents to the questionnaire we administered to the participants to this project.

for example a broken statue complemented by a hologram that reconstructs the missing part, see section 2.1.3.C above). Questions might arise as per who would provide police and courts for such cases between private entities or the states.

4.1.4 Children

Virtual worlds may require higher levels of protection targeted at specific users. Based on the audience, the environment, and activities that are carried out, there may be a need to create walled-gardens (or protected 'nests').[39] For instance, an important toy manufacturer has launched a virtual world targeted at children, who clearly have unique needs for safety and security that shall be specifically tackled. Means to cope with such needs are several: for instance, one way could be to create child-specific spaces with special safeguards; alternatively – or in addition – communication and privacy preferences for child accounts could be adjusted to limit certain interactions. In both cases, the legal threshold for minors to provide valid consent to data treatment should be reconsidered.

4.2 Mass Content Creation

One of the main legal issues related to mass content creation is intellectual property protection. According to the EC, contents in virtual worlds should comply with relevant regulations exactly as it would happen in the real world.

Together with human creators, virtual worlds are filled with other entities that might equally produce content: among them, a prominent role will be increasingly played by generative AI tools. For instance, conversational AI will help implementing "digital humans": the latter will act as 3D versions of present chatbots to interact with humans in virtual worlds.[40]

In addition to monetary incentives and 'likes', increased visibility may also create incentives for content creators. One way to do that would be to widen the audience as much as possible or enhancing the possibility to massively create (for example through generative AI): for instance, by letting users create more content about a company's brand, product or platform, the company's digital footprint and brand's reach may grow exponentially .[41]

4.3 Technology and Infrastructures: Incentives

As previously mentioned, the full deployment of virtual worlds requires several technologies and infrastructures.

From a policy perspective, a technologically neutral approach shall be preferred. Nonetheless, one should consider that several layers are affected, including both software (related to each virtual world) and hardware (composed of human-machine interfaces, servers, networks, and so on).

[39] UNICEF (2023), The Metaverse, Extended Reality and Children, Report, May, available at the following link https://www.unicef.org/globalinsight/reports/metaverse-extended-reality-and-children; Europol (2022), Policing in the metaverse: what law enforcement needs to know, cited under fn. 29, at 17.

[40] Conversational AI and Virtual Assistant Trends for 2022, 3 December 2021 (available at: https://www.cbot.ai/conversational-ai-and-virtual-assistant-trends-for-2022/

[41] Ibid.

Hence, the whole process can either be left to the market (with the risk that some enabling layers will not materialise) or be facilitated by policy intervention (with the risk of incentivising the wrong layer's component). However, it should be emphasised that public intervention to (directly) set standards might conflict with the principle of technological neutrality. Therefore, any intervention aimed at prioritising any sector (either infrastructures,[42] or emerging technologies or players) should be subject to prior ascertaining of its indispensability for the functioning of the virtual worlds ecosystem.[43]

With reference to human-computer interfaces (HCI), as of today, no specific standardisation effort has been promoted by public bodies, only private initiatives exist to this end, [44] like the International Electrotechnical Commission.[45] The proposed Data Act does however contain a set of rules on open interfaces (under Art. 26 (2)).

4.4 Governance: Interoperability and Standardisation

Nowadays, we still only have walled virtual worlds, insulated one from the next, which are based on different software, not designed to interoperate with each other nor based on compatible technologies; they support different human-machine interface and do not allow seamless movement of IDs, avatars or digital objects.

As mentioned,[46] both the WEF and the U.S. CRC, as well as the scholarship,[47] maintain that in its Infant stage of development (although not at current Birth stage), virtual worlds are interconnected and interoperable. This idea raises challenges with regard to both vertical and horizontal interoperability, as well as harmonised standards that need to be tackled.

Interoperability is, at present, a highly debated and salient issue in the EU regulatory agenda. Vertical interoperability connecting different components within single virtual worlds is, as mentioned, needed for virtual worlds to expand and, therefore, cooperation among stakeholders in this regard is wide (above, 3.4). Such collaboration across industries should be regarded as positive and possibly sustained via the setting of competitive research and development (R&D) framework conditions, so to boost innovation and competitiveness. Horizontal interoperability, on the other hand, would entail interconnection and interoperability across virtual worlds (for instance, by means of Application Programming Interfaces (APIs) or other technologies),[48] and is therefore questionable if, how, and to what extent it should be pursued and by whom. In any event, both types of interoperability are relevant to reach virtual worlds' maturity (the metaverse).As mentioned, horizontal interoperability triggers more challenges than vertical, although it can make all virtual worlds accessible from any

[42] See above under section 3.3
[43] This is not in line with what the EC seems eager to do: "It is essential that EU start-ups and SMEs benefit from enabling framework conditions to help them innovate". (p. 2).
[44] See above fn 8
[45] IEC TR 63344:2021 Conceptual model of standardization for haptic multimedia systems; IEC TR 63308:2021 Virtual reality equipment and systems - Market, technology and standards requirements.
[46] See above, 2.1.1.
[47] See above, 2.1.2.
[48] See e.g. WebXR, an open protocol API allowing to browse different virtual worlds through the web: https://immersiveweb.dev/

point, and especially explorable in their entirety, thus increasing their overall attractiveness (both for experiential and business purposes).

In general, imposing early requirements on horizontal interoperability on components (like devices) which are highly differentiated and where players are innovating to compete – especially at Birth stage of development of these markets and technologies – may affect innovation and incentives. Also, the risk to commoditise a space which is highly competitive at Birth stage should not be underestimated, especially considering that users' demand is still growing and use cases of fully interoperable virtual worlds (that is, Infancy stage) have not yet emerged. At the same time, however, for market operators to develop of a wide range of XR technologies, the standardization of some key features of human-computer interfaces may be beneficial.[49]

At Infancy stage, however, the scenario is different: to increase accessibility and inclusivity, but also to unleash the full potential of virtual worlds for all industry sectors and for society, it could be desirable that different devices and interfaces be used to access several virtual worlds. In this scenario, establishing open, cross-device and consumer-centered standards to ensure interoperability may reduce market fragmentation while making virtual worlds an economic and societal success. However, it is debated whether full uniformity of minimum standards for devices and interfaces in different virtual worlds should be established or not and their likely impact on competition. Considering that virtual worlds at this stage transcend borders, any initiative on standards' harmonization should keep a focus on cross-jurisdictionality.

Interoperability and standardisation can be either imposed by regulation or be achieved upon initiative of market players, aimed at developing common standards, mixes of the two exist as well. Looking at EU initiatives on interoperability and standardisation, the EU already provides many examples of regulatory approach employed to face market failures, for instance Art. 5 of the DMA or Art. 36 of the revised Payment Services Directive (PSD2).

Currently, the most relevant initiative at the EU level is the proposed Data Act. The Act entrusts the EC with the power to promote interoperability[50] of data spaces[51] (Art. 28) and data processing services[52] (Art. 29). While the former consist of purpose- or sector-specific or cross-sectoral, interoperable frameworks of common standards (needed to share or jointly process data), 'data processing services' are essentially cloud and edge services.[53] From an institutional angle, the proposed Data Act allows the EC to adopt "essential requirements" on a number of relevant features

[49] See in this regard the (already-mentioned) Snapdragon foundation's platform which helps developers collaborate to integrate XR technologies (for instance, they optimized a head-worn AR platform for AR glasses tethered to smartphones with a Khronos OpenXR standards conformant runtime).

[50] Art. 2(19) proposed Data Act. 'interoperability' means "the ability of two or more data-based serviced, including data spaces or communication networks, systems, products, applications or components to process, exchange and use data in order to perform their functions in an accurate, effective and consistent manner".

[51] Art. 2(20)(a) proposed Data Act (defining 'Common European Data Spaces). See also https://joinup.ec.europa.eu/collection/semic-support-centre/data-spaces

[52] Art. 2(1)(12) proposed Data Act (defining Data processing services).

[53] CERRE Report on Data Act: towards a balanced EU data regulation, March 2023, at 79 (available at https://cerre.eu/publications/data-act-towards-a-balanced-eu-data-regulation/).

of data spaces (Art. 28(1))[54] including APIs. In regulatory terms, these requirements are assimilated to harmonised standards and therefore binding.[55] In addition, the EC can request SSOs to adopt harmonised interoperability standards (that comply with its own essential requirements). When exercising this power, the EC shall implement principles of openness, transparency, technology-neutrality and ensure the widest participation of stakeholders, as laid down in EU Regulation 1025/2012 (on standardisation).[56]

Although not yet adopted, the Data Act will affect interoperability in virtual worlds, but only to a limited extent. Horizontal interoperability is expressly addressed in Art. 29(1), imposing interoperability obligations on data processing service providers for services 'of the same service type'. Essentially, that means that cloud computing and edge services supplied by different providers should become interoperable and interconnect. In specifying what standards for data processing services should aim at, Art. 29(1)(b) of the proposed Data Act mentions the need to 'enhance portability of digital assets between different data processing services that cover equivalent services'.[57]

As per vertical interoperability, the DMA already contains several provisions to mandate it, but only to gatekeepers (that is, economically powerful players). The proposed Data Act, which is a horizontal legislation applying to all players (except for small and micro entreprises), seems to generally welcome mix and match of different sets of data services into service ensembles. Examples can be found in Art. 26 (3) and Art. 29 of the Data Act, which provide that interoperability shall be achieved between data processing services (including the ones provided in the context of platform-as-a-service and software-as-a service models).

4.5 Skepticism and Sustainability

4.5.1 Skepticism

Although massive investments have been made in virtual worlds over the years (and many are ongoing with new technologies and human-machine interfaces recently launched on the market that promise to make interaction easier, more engaging, and richer in potential), skepticism still surrounds virtual worlds.[58] This is probably primarily due to consumers or people being skeptical towards new things. current low demand,[59] unripe development, and long-term timeline for realisation, which bring some to believe that investments on virtual worlds are misplaced. However, among investors and companies involved in the development of services associated with virtual worlds, there is a

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[54] E,g, content and quality; data structure; licenses, and means to enable interoperability of contracts for data sharing.

[55] Adopted in conformity with EU Regulation 1025/2012.

56 See the EU Council's position on the Data Act, proposed amendments to Art. 29(3), P9 TA(2023)0069, 14.3.2023.

[57] Art. 29(1)(b)

[58] E. Zitron (2023), RIP Metaverse, An obituary for the latest fad to join the tech graveyard, 8 May, available at the following link https://www.businessinsider.com/metaverse-dead-obituary-facebook-mark-zuckerberg-tech-fad-ai-chatgpt-2023-5?r=US&IR=T.

[59] While the EU is taking steps in the area of virtual worlds, in other world regions (e.g. the U.S. mainly) the hype around metaverses is dying down: users seem to be more interested in other types of experiences and/or very specific immersive technologies' use-case. See L. Harris (2022), The metaverse: is it alive or is it dead?, 1 March, available at the following link https://www.thedrum.com/opinion/2022/03/01/the-metaverse-it-alive-or-it-dead; and A. Hasnain (2023), The Uncertain Future of the Metaverse: Trends and Skepticism, 12 May, available at the following link https://www.digitalinformationworld.com/2023/05/the-uncertain-future-of-metaverse.html

considerable interest,[60] and users with a higher level of specific skills are generally engaged and enthusiastic.[61] With regards to user experience, the users' disappointment could be attributable to unsatisfactory experiences in the face of high expectations, or the fact that the current the state of technological and service evolution enables only limited graphically and interconnected experiences. With the further development of virtual worlds, the subsequent greater accessibility of devices and technologies would help in tackling the current skepticism.[62] In addition, IT literacy has the potential to empower users, enabling them to more adequately understand the opportunities (as well as the risks related to privacy, cybersecurity, or prolonged connectivity, for example) and enjoy effectively the virtual worlds user experience (either as recipients of services or content creators) gaining greater awareness.

4.5.2 Economic and environmental sustainability

Other challenges pertain to sustainability, both referring to its economic and environmental dimensions.

With regards to the economic sustainability of business models, each use case has its own specificities, but in all cases the investments for the creation (and management) of virtual worlds need to be economically viable. Considering the current limited user base, estimated growth should be evaluated by policy makers by relying on market players' data. Consideration should also be given to whether, in the case of the transfer of assets from one virtual world to another, pricing schemes should be envisaged to reduce transactional costs.

As for environmental sustainability,[63] a number of concerns arise: first and foremost the high energy consumption of the servers on which virtual worlds are based. As the product graphics quality increases and the number of interactions and user-created content grows, the use of energy will also rise. However, in this respect, much will depend on the type of technologies and protocols used, which have very different levels of energy consumption[64]: decentralised technologies tend to result in higher energy consumption than centralised ones, for instance.[65]

The manufacturing of equipment and devices (headsets, servers, and so on) may also have a significant environmental impact. Such devices are composed of many elements that are complex to dispose of.

[60] See J. Dalton (2023), PwC's Metaverse Deals Tracker highlights the investments that a broad range of players are making in the next digital platforms, April 5, available at the following link https://www.pwc.com/gx/en/industries/tmt/media/outlook/metaverse-investments-tracker.html

[61] Accenture (2023), Growing Consumer and Business Interest in the Metaverse Expected to Fuel Trillion Dollar Opportunity for Commerce, Accenture Finds, January, available at the following link https://newsroom.accenture.com/news/growing-consumer-and-business-interest-in-the-metaverse-expected-to-fuel-trillion-dollar-opportunity-for-commerce-accenture-finds.htm

[62] A recent survey conducted by PwC gathered consumer and business expectations on the development of virtual worlds. See PwC 2022 US Metaverse Survey available at https://www.pwc.com/us/en/tech-effect/emerging-tech/metaverse-survey.html

[63] See M. Birkebæk Jensen, S.G. Lauridsen (2022), Shaping the metaverse towards sustainability, KPMG available at the following link https://kpmg.com/dk/en/home/insights/2022/12/shaping-the-metaverse-towards-sustainability.html; P. Chakrabarti, H. Ogunyanwo, F. Isaac, T. Aguiar (2023), ESG in the Metaverse: An Opportunity to Rethink Sustainability, Bloomberg Law, March, available at the following link https://www.bloomberglaw.com/external/document/XD81F1N4000000/esg-professional-perspective-esg-in-the-metaverse-an-opportunity.

[64] For a good practice in terms of chips' energy consumption see: https://www.qualcomm.com/news/onq/2021/02/how-our-power-efficient-technologies-benefit-smartphone-users-and-earth

[65] P. De Giovanni (2023), Sustainability of the Metaverse: A Transition to Industry 5.0. Sustainability, 15, p. 6079. https://doi.org/10.3390/su15076079

Moreover, considered the rapid technological change, products become very soon obsolescent, thus the environmental impact of such waste should be assessed.

The digitisation effort may not only fail to be energy sustainable, but also undermine the ecological transition goals pursued by the European Green Deal and Next Generation EU. Therefore, due consideration must be given to environmental sustainability objectives in the design of virtual worlds and their characteristics as well as in the manufacturing of physical interfaces (such as visors). In this regard, the EU Ecodesign legislation[66] sets obligations to significantly improve circularity, energy performance, and other environmental sustainability goals for physical goods placed on the EU market However, it is essential that sustainability goals are also pursued outside the specific scope of these regulatory provisions. Furthermore, being aware of the global nature of the virtual worlds, consideration must also be given to forms of pollution that occur in areas outside the EU, that are instrumental for the provision of services (also) in Europe.

[66] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products.

5. RECOMMENDATIONS

The following recommendations will be further developed in the forthcoming Final Report that is part of this project. As of now,

- We suggest that the EC's definition of virtual worlds is extended to incorporate the key features identified in our proposed definition, especially mass content creation and interoperability. We also suggest drawing a distinction between the characteristics of the different development phases of virtual worlds (Birth, Infancy, Maturity). In this way, the use of different terms (like metaverse) by the business and press communities, as well as society would no longer be a means of confusion. The policy discourse on virtual worlds should be built on the features and related challenges they raise rather than focusing (solely) on their principal characters (immersivity, persistence, synchronicity). Features raising distinctive challenges should include: user experience, mass content creation/production, technology and infrastructure, and governance. Therefore, it is recommended to adopt a functional definition, similar to the one we have proposed, to assess the desirability of harmonised standards, connectivity requests, the setting of incentives, and evaluation of collaborations.

- Consider a plethora of possible tools (not just rules and harmonised standards) when assessing if and how to intervene on the challenging features (for instance, that of accountability of users and providers of virtual worlds). In this respect, industry-developed technological tools (elements implemented by design in the structure of virtual worlds that could allow users to be held liable for actions performed by avatars, for example) or incentives of different kinds (monetary, but also community-based remuneration of interaction) could be considered in the first place.

- Consider promoting (in a cooperative fashion) forms of harmonised standardisation (on minimum enabling elements), including through the definition of open standards. The role of institutions in guiding this path could be significant, as it could facilitate the transition of virtual worlds from their current Birth state towards more mature versions (Infancy). Harmonised standardisation should be limited to specific and essential features and not constitute a limitation for development or detriment to private investment and innovation more broadly

- Incentivise the development of virtual worlds in general (through the setting of incentives to foster collaboration, projects, and infrastructure) and environmentally sustainable technologies.

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