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A FEDERATED NETWORK ARCHITECTURE PERSPECTIVE ON THE FUTURE OF THE METAVERSE

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Abstract

We draw upon the concept of federated network architectures to better understand whether the Metaverse will develop into a 'uni-verse' or a 'multi-verse'. We incorporate a historical research perspective enhanced with semi-structured interviews with experts, who are involved in developing and investing in the Metaverse. Our findings showcase that the Metaverse will develop into an expansive three-dimensional simulated reality, offering a large range of functionalities. Moreover, the insights of experts show that the Metaverse will most likely first develop into a 'multi-verse', through a collection of separate platforms each with its own function. The findings of our study, therefore, bear timely and topical insights for research as it is in line with the recent Information Systems research agenda and the industry. We discuss the implications of our study for both theory and practice, while we delineate an agenda for future research on the topic.

Keywords: Federated Network Architecture, Metaverse, Web 3.0

1.0 Introduction

The Metaverse represents a digital platform ecosystem (DPE) (Xi et al., 2022), which makes use of emerging technologies to offer immersive digital environments that simulate real-world experiences (e.g., Chaturvedi et al., 2011; Far & Rad, 2022). Immersive digital environments have been available for over 20 years (Saunders et al., 2011) and have often been described as predecessors of the Metaverse (Polyviou & Pappas, 2022). One such example is Second Life, which is an online virtual world, launched in 2003, where users can perform a plethora of activities including interacting within social spaces, exchanging, and trading items, and building landscapes (e.g., Gent, 2022; Ludlow & Wallace, 2007; Makineni et al., 2009). The Metaverse, however, differs from previous attempts to create digital worlds that offer immersive experiences due to its use of novel digital technologies (Nakavachara & Saengchote, 2022), specifically associated with Distributed Ledger Technology (DLT), artificial intelligence (AI), augmented reality (AR), virtual reality (VR), the internet of things (IoT), as well as other Web 3.0 and DPE-related technologies (Gregory & Henfridsson, 2021), which enable the construction, mapping, and archival of virtual spaces and experiences (Mozumder et al., 2022). For instance, the Metaverse is built upon foundational technologies such as DLT, which decentralizes and distributes ledgers that hold records of digital assets (Xu et al., 2022). This enables the Metaverse to use a federated blockchain network architecture to interoperate (Qi et al., 2021) without using raw consumer data (e.g., Angelopoulos et al., 2021), which ensures privacy and security and guarantees the reliability of data and transactions (Jeon et al., 2022).

Such an architecture has mainly been used in finance, banking, logistics and insurance sectors to date, however, the creation of the Metaverse is further expanding the potential for blockchain technology (Gatteschi et al., 2018; Gillpatrick et al., 2022). This has sparked debates among academics and practitioners about the implications of such a DPE due to the potential impact the Metaverse could have on many sectors including marketing, healthcare, education, retail, commercial entertainment, social spaces and much more (Dwivedi et al., 2022; Fernandez & Hui, 2022). Consequently, the Metaverse is seen to have the potential to go beyond a workspace, and market virtual space, as there have been investments as well as interest from finance, art, fashion, real

estate, music, healthcare, and social sectors (van Rijmenam, 2022), and its potential stands in parallel to a plethora of activities performed by consumers and businesses in the physical world such as gambling, sports, and shopping. The Metaverse, therefore, can open social and business activities up to a richer set of applications and can enable the same kind of explosion that the internet caused with computer networking. Commercial confidence in the Metaverse, even at such an early stage, has been suggested by its high valuation at US$21 billion, which suggests its potential, and as such, its future seems worth exploring.

This study aims to shed light on the evolution of DPEs by exploring the possible future directions of the Metaverse and answering the question as to whether it will become a '*uni-verse*' or a '*multi-verse*'. By '*uni-verse*' we refer to a single platform capable of fulfilling multiple functions across many sectors, all within a single, however large, 'space'. On the other hand, our reflection of a '*multi-verse*' refers to a collection of separate platforms that each offer their own digital space to fulfil a particular function. Ultimately regardless of whether the Metaverse evolves into a '*uni-verse*' or a '*multi-verse*' the functions will be the same, but the user experience will be fundamentally different. For instance, if the Metaverse becomes a '*uni-verse*' users will have a more localized experience allowing them to perform desired functions within one space, whereas in a '*multi-verse*' users will need to move between separate platforms depending on the desired task.

We take a historical research perspective and seek experts' opinions on the future of such a DPE, alongside archival and historical analysis on the broader evolution of federated networks such as the Web and the Internet. Much of the previous literature has reviewed the early stages of the Metaverse and predicted its significant growth (Choi & Kim, 2017; Damar, 2021), however, little research examines what such a DPE will evolve into. Our study, therefore, bears timely and topical insights for research as it is in line with the recent Information Systems (IS) research agenda (La Paz et al., 2020; Struijk et al., 2022). Our research project also presents significant implications for practice (Davison, 2022) by enabling decision-makers to further understand the benefits of the Metaverse.

The remainder of our paper is as follows. Following this brief introduction, the next section presents the literature review which introduces the concept of the Metaverse and the perspective of the federated network architectures. The third

section describes the methodology on historical research and experts' opinions, while in the fourth section, we present the findings of our study. The penultimate section presents a discussion of our contribution to theory and practice, while we conclude the paper by delineating an agenda for future research on the topic.

2.0 Literature Review

The Metaverse represents a DPE (Xi et al., 2022), which makes use of emerging technologies to offer immersive environments that simulate real-world experiences (e.g., Chaturvedi et al., 2011; Far & Rad, 2022; Saunders et al., 2011). Using AR and VR technology, the Metaverse offers parallels to activities within the physical world where real people and their avatars can interact. The potential for this DPE is increasingly being explored by businesses to understand how it can be integrated with current business models to offer experiences, products, and services to customers (Dwivedi et al., 2022). One example is the Metaverse can facilitate the consumer sector to fuse traditional retail and e-commerce marketplaces to expand to the next phase of business growth (Navarro & Thakkar, 2022). The extent of this opportunity has not fully been explored yet, although it is clear the potential for organizations to adapt their business models using the Metaverse is significant (Dick, 2021; Dwivedi et al., 2022; Mystakidis, 2022). Still, this has not stopped organizations from investing. For instance, the Metaverse is increasingly populated by consumer brands that establish virtual stores and sell digital assets in the form of non-fungible tokens (NFT). Brands such as Gucci and Nike, for example, have released NFT bags and trainers that can be bought, sold, and used within the Metaverse (e.g., Joy et al., 2022).

Other major technology giants have also invested in the Metaverse, positing the potential for the Metaverse in being a virtual space for business activity (Egliston & Carter, 2022). One such company is Microsoft, which has invested in the Metaverse with plans to use immersive technologies for virtual meetings, allowing people to move between the virtual worlds during their workday, whilst Meta plans to offer virtual spaces where people can socialize together. To that end, the Metaverse has the potential to offer a space to various sectors and it is unclear what form this will be and whether one sector will be dominant or whether

all will exist equally. Other industries such as the gambling sector, also have potential within the Metaverse due to fewer regulations than physical casinos (Salmasi & Gillam, 2009). In the travel and automotive industries, the Metaverse can enable virtual tours and test drives, while in the financial sector organizations can incorporate new technologies towards new digital pathways including cryptocurrencies (Akkus et al., 2022). The Metaverse could also be adopted by healthcare professionals (e.g., Skalidis et al., 2022; Taylor et al., 2021), as well as marketeers, as it presents opportunities to engage with all types of consumers.

Metaverse development, thus far, has been very much oriented around the creation of a sense of community for users (Cai et al., 2022; Choi et al., 2022; Tayal et al., 2022). The Metaverse has been described as an interactive digital community ecosystem (Duan et al., 2021), where the focus is now on community and relationship building with business-to-customer and customer-to-customer (Almeida et al., 2014). This sense of community is defined as a group of individuals with similar interests and purpose who are not bound by physical geography (Ridings & Gefen, 2004). Community building, however, can have positive effects on purchase intent and by building a community between users and businesses within the Metaverse, purchase intent and sales may increase. This is because positive consumer-brand relationships have been shown to promote stronger positive views of brands and experiences which ultimately generate long-term relationships which boost purchase intent and sales (Andersen, 2001; Smith & Rose, 2020). In this case, the sense of community within the Metaverse is something which marketeers can take advantage of. However, the ways in which marketeers can utilize this sense of community have not yet been fully explored.

The above literature also demonstrates interest from many sectors and as such posits the question as to whether the Metaverse will evolve towards a social space, a workspace or another "space" altogether. The literature has reviewed its early stages and has predicted its significant growth (Choi & Kim, 2017; Damar, 2021). Little research, however, examines what such a DPE will evolve to. Some studies suggest that the Metaverse will be an immersive space to allow consumers to virtually socialize, play games, and attend concerts (Wiederhold, 2022) whereas others suggest it will be a space for business activities to progress virtually alongside physical spaces, transforming how organizations interact with

consumers. The question, thus, arises as to whether the Metaverse will become a '*uni-verse*', encompassing many aspects in one space, or will it evolve towards a federation of platforms creating a '*multi-verse*' where each of these focuses on one aspect of the contemporary lifestyle, such as work or social interactivity?

The development of the Metaverse is in a similar phase to the early stages of internet development. The internet can be viewed as a collection of communities or a collection of technologies, which satisfy basic needs and utilize these effectively to expand and develop the infrastructure (Leiner et al., 1997). This parallels with views of the Metaverse, which has been described as a new iteration or expansion of the internet which utilizes blockchain technology, VR headsets and avatars in integration between the physical and virtual worlds (Dwivedi et al., 2022; Lee et al., 2021). As the Metaverse is today, in the early stages of development, the internet was viewed controversially (e.g., Eschenfelder et al., 2011; Santaniello, 2021) but now the internet has approximately 5 billion users. Equally the Metaverse, is viewed controversially but Web 3.0, NFT, blockchain, and games are used by millions of users (Kshetri, 2022) and this is expected to rise to over 1 billion users by 2027 (*ibid*). By comparing the Metaverse to the internet during its early stage of development, the methods of overcoming these controversies may become clearer. For instance, whilst the internet seemed, in the early stages, to provide benefits for consumers, many were sceptical about using it to purchase items rather than shopping in stores (Jarvenpaa et al., 1999). This may be because the internet was a new technology which individuals did not trust or understand. This, therefore, could be the case with the Metaverse as it is built using blockchain technology with a new form of payments using cryptocurrencies which many do not understand yet. Thus, creating a better understanding of the new DPE may be the key to creating this widespread use that the internet sees today. Equally, there was widespread distrust towards the internet during the early stages of internet adoption (Culnan & Armstrong, 1999). This distrust was found to be because of depending on the unknown when sharing personal information online. This suggests when information privacy is involved, individuals can show distrust when dealing with a new platform as the consumers are unaware of how this information will be shared and used. This shows parallels with current controversial views of the Metaverse where individuals are sceptical

as it is open source and decentralized so payment information, as well as other private information, can be readily available to anyone using the platform (Saha et al., 2019; Xiong et al., 2020). This, therefore, suggests educating new users may be important as many individuals are sceptical about using this new technology.

This distrust of the internet existed to a greater extent before the late 90s when Google was created (Meier-Hahn, 2015). Google created a central point for users to search from and to find the web pages they needed, whereas before this point many thought the internet had barriers to entry and could not understand how to use the internet (Katz & Aspden, 1997). Currently, the Metaverse has no equivalent interoperability to Google and as such, individuals need to know which 'world' or space to enter within the Metaverse to attend the activity or play the game they wish. Without this, some individuals struggle to transition between different 'worlds' within the Metaverse due to this difficulty with interoperability. This, as a result, creates a large barrier to entry to the Metaverse. This, therefore, posits the idea that Metaverse interoperability may need to improve for the Metaverse to become as popular as the internet is today.

3.0 Methodology

3.1 Data Collection

The participants were recruited through a purposive sampling approach, more specifically through *expert sampling* (Etikan et al., 2016) through LinkedIn. Participants were chosen based on their work experience and interests. Three types of experts were recruited i) investors, ii) developers, and iii) marketeers related to the Metaverse. These experts were chosen for their active involvement in building and helping to create the future of the Metaverse. The commonalities between their projections represent aspects that will likely be indicative of the Metaverse's structure. Eleven participants took part in the study overall. Table 1 shows the participants' roles and types of expertise. Recruiting experts from these groups allows for a more representative breadth of views; it is important to note that some participants fell into more than one category of 'expert'.

Participant	Profession	Expertise
A	Run a marketing agency and content studio	Developer
B	Provides financial and personal support to entrepreneurs	Investor
C	Marketing coordinator	Marketeer, Investor
D	Company founder	Developer
E	Marketing team	Marketeer, Developer
F	Company founder	Developer
G	Chief marketing officer	Marketeer, Developer, Investor
H	Lead of Web3.0 studio	Developer
I	CEO	Developer
J	Marketing director	Marketeer, Developer
K	CEO	Developer

Table 1. Participants' characteristics

The participants were provided with information outlining the aims of the study, the types of questions, the absence of risk for taking part, their right to withdraw at any point and that their responses would be anonymous. They also signed a consent form agreeing to take part in the study. The data collection was conducted using a semi-structured interview protocol, which allowed participants to steer the conversation to include any information they thought may be important as well as allowing the interviewer to ask any follow-up questions. The semi-structured protocol also reduced potential biases in the questions as participants were able to respond freely and change the direction of the discussion depending on their experience, or information they deemed important. The interview protocol involved questions about the participants' understanding of the Metaverse, relevant projects which they were working on, and their reflection on the Metaverse's future. The interviews were recorded and transcribed, with the participants' permission, to allow participants to confirm their input before the analysis was conducted. Each interview lasted approximately 30 minutes. Following the interview, the participants were debriefed. This reminded participants of the aims of the study, that their responses were anonymized, and allowed them to ask any other questions or raise concerns. The data were then collated for analysis and stored on a password-protected personal computer.

3.2 Data Analysis

We followed a thematic analysis approach, which can be described as a method to identify, analyze, and report patterns, or themes, within a qualitative data set (Braun & Clarke, 2006). Themes represent important aspects within the data and highlight the pattern in responses. These themes also do not have to be the most prevalent aspects of the information but can be parts of the data which hold the most importance about the research question (*ibid*).

Thematic analyses can be conducted at two levels: semantic, and latent. The semantic thematic analysis involves an explicit analytic process where the descriptions from participants are organized into patterns or themes which are interpreted to understand the patterns' significance as well as broader implications and meanings of them (Boyatzis, 1998; Patton, 1990). Whereas a latent thematic analysis involves examining underlying assumptions, ideas, and conceptualizations about the key patterns highlighted in the data (Braun & Clarke, 2006). For our study, a semantic thematic analysis was conducted. Thematic analyses follow six stages: data familiarization, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Firstly, the data familiarization process took place during the transcription and subsequent readings of the interviews. Next, the generation of initial codes took place. This involved identifying aspects of the data which appear interesting or noteworthy. As such these were noted down to create the first 'organization' of the data into meaningful groups (Tuckett, 2005). The third stage began once all data was initially collated and coded. During this stage, the codes were grouped to generate broader themes, but other codes which stood alone, or which were deemed less important were deleted to create a better reflection of the data (Miles et al., 2018). Stage four involved reviewing the themes to identify which themes needed refining, breaking down or deleting, if any, to identify the different themes and how they fit together to create the overall picture of the data. Finally, these themes were defined to create seven themes altogether.

4.0 Findings

The key themes that arose from the analysis of the interviews with regards to what the Metaverse means to each participant were as follows: The Metaverse is defined by digital ownership, it is a 3D social media platform, and it is expansive with little boundary on functionality. We depict a visual representation of our thematic analysis data structure in Figure 1. Most participants explicitly stated that the Metaverse should be defined as a shared, 3D virtual reality. The primary functions, however, of this virtual reality differed among participants. Participant F, for example, stated that the defining characteristic and function of the Metaverse is that "*consumers and users are able to own things within the Metaverse*". In this firmly Web3.0 vision of a Metaverse built upon blockchain technology, the actual interface, "*whether it's AR, whether it's PR, whether it's a virtual world, whether it's a community, whether it's chat life or whatever else*" is a secondary concern.

By contrast, Participant I sees the Metaverse as being a "*3D social media platform*" at its core. In such a conception of the DPE, DLT provides an ancillary supportive role that may aid the function of the Metaverse as a 3D social media platform but remains non-essential. Participant E also sees the Metaverse as a "*3D version of your digital identity [...] kind of like your profile page but a 3D version*". Other participants kept their visions of the Metaverse more loosely defined and more expansive. Participant B stated that the Metaverse is a space "*where you can play, where you can learn, eventually, you can create your own revenue streams*" while Participant C remarked that "*you can not only play games in the Metaverse, but you could socialize, you could shop, you could work*". Participants G, A, and J share this broader conception whilst H and D sit between E's focus on the social function of the Metaverse and B's expansive outlook. Participant K explicitly stated that they were "*anti-definition*", yet still described the Metaverse as a platform that simulates "*what we do in real life*" and *"an all-encompassing world*", thus closely aligned with those participants that view Metaverse as an expansive virtual environment hosting many activities and providing many functionalities.

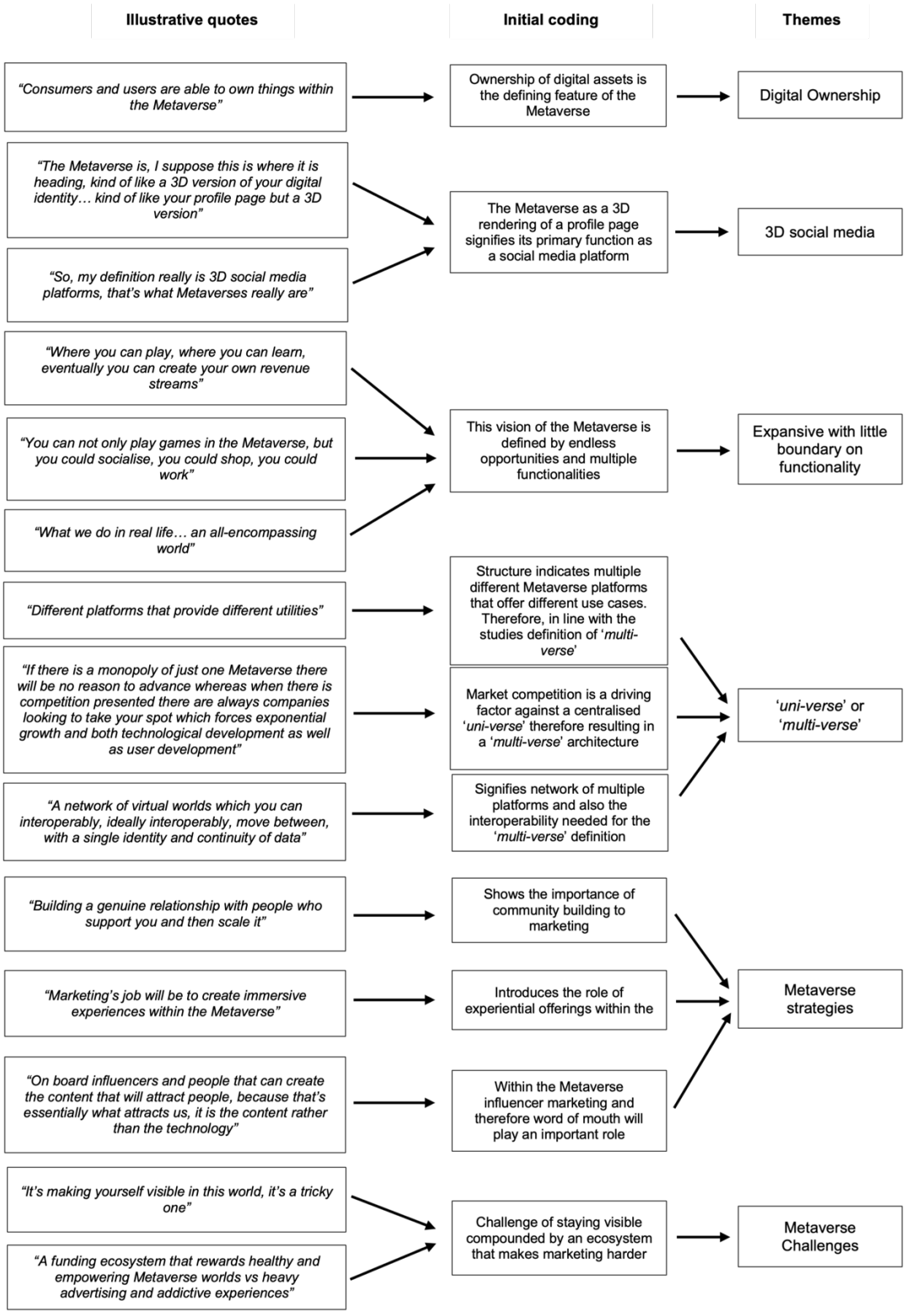

Figure 1. Data Structure

The interviews revealed that most participants saw the Metaverse subsuming the existing internet. Consumers will spend more time in the Metaverse as offerings there combine with a fully realized 3D version of the existing internet. In essence, the participants of our study see that the internet as we know it will simply become the Metaverse. Participant C presented one notable alternative vision, suggesting that engaging with the Metaverse will become more of a choice than the advent of the internet. As such, the two may continue to coexist alongside each other with different use cases. Such coexistence is echoed by Participant K who sees Web 3.0 operating alongside Web 2.0 until people become "*more comfortable with building worlds than they were with websites*" to "*represent themselves*".

The interviews revealed that all participants envisioned the Metaverse consisting of a federated collection of platforms and, therefore, consistent with the definition of a '*multi-verse*' provided in this research. Participant D, for example, saw the Metaverse as a collection of "*different platforms that provide different utilities*". Participant C remarks that the likelihood of the Metaverse becoming a '*multi-verse*' stems from market competition: "*If there is a monopoly of just one Metaverse there would be no reason to advance whereas when there is competition presented there are always companies looking to take your spot which forces exponential growth and both technological development as well as user development*". The greatest degree of tension among participants, however, was the issue of interoperability between these platforms. Participant H sees the Metaverse "*as a network of virtual worlds which you can interoperably, ideally interoperably, move between, with a single identity and a continuity of data*". Similar sentiments were expressed by Participants I, G, E, B, C, and K who specifically referenced the "*Metaverse Standards Forum*", a body attempting to create standardized rules. Participant J took a more nuanced approached, stating that there will be multiple platforms where "*some will be interoperable, and others won't*". From a more skeptical position, A remarked that "*the idea of multiple interconnected spaces does not sound realistic. Competitive projects[…] will be incentivized to keep users in their own ecosystems*". Participant F also said that there would be no single standard to support mass interoperability.

5.0 Discussion

5.1 Implications for Theory and Practice

Our study represents an early attempt to develop a greater understanding of the Metaverse's structure, through projections from experts. The key findings of this study were that i) most industry experts envision the Metaverse as an all-encompassing platform that simulates real-world activities and functionalities, ii) the Metaverse will subsume the existing internet incorporating its offerings into the 3D virtual ecosystem, iii) the projections made by the participants see the Metaverse becoming a '*multi-verse*', a collection of distinct platforms acting as modules within a federated network architecture; most experts saw these worlds as interoperable as opposed to 'walled gardens' and a centralized '*uni-verse*'.

Despite the growth in literature, financial investment, and media attention on the Metaverse, it remains an abstract DPE. The participants of our study were invited to share their insights on their conception of the Metaverse to further develop an understanding of its potential future. Our participants were chosen for their active role in building the Metaverse. Where their projections converge, it can be said that these aspects will become constituent parts of the Metaverse. The fact that the majority of participants stated that the Metaverse would become an expansive space of leisure, learning, socialization, and work has several broad implications. A Metaverse that facilitates such a range of activities and functionalities will capture a great deal of user attention to the point of becoming integral to day-to-day life (Babu & Mohan, 2022). To both support and capitalize on this user attention, commercial presence in this expansive Metaverse will be far greater than the social media Metaverse envisioned by Participants I and E.

All participants stated that the Metaverse would become a '*multi-verse'*, a federation of platforms that act as individual modules within the network of Metaverses rather than a centralized *'uni-verse'*. The contentious point between participants, however, was the issue of interoperability, with some envisioning a completely interoperable system built upon standardized rules, others seeing some spaces as interoperable and some maintaining walled gardens, and others suggesting there would be no interoperability. Overall, however, the consensus was that interoperability would become a foundational layer of a '*multi-versal*'

Metaverse. This finding supports the literature albeit from a different perspective. For example, Participant C's comment that the Metaverse will likely operate as an interconnected *'muti-verse'* because of continuous market competition, reaches the same conclusion as Garon (2022) but from an alternate lens. For Garon (2022), who writes from a legal perspective, a single ubiquitous Metaverse cannot support a common global experience because of the variation of regulatory statutes across the world. Access to the internet, and the governance of it through domestic law, varies greatly across nations, which will be exacerbated, not flattened, by the growing adoption of the Metaverse (*ibid*).

Another example of a study that corroborates the focus of our participants on interoperability is Lim et al. (2022), who discusses the need for interoperability to support the seamless vision of the Metaverse and to allow for the proliferation of user-generated content. Taking our findings and these points of prior research into account, a clearer picture of the Metaverse's future has developed. The Metaverse will likely develop into a '*multi-verse*' because of continuous market competition that pushes technological advances and improved user experience as well as varying legal regulations enforced by nation-states. Interoperability too, as confirmed by the participants, will become an essential core for the Metaverse whilst Lim et al. (2022) add more specificity by claiming that interoperability will be necessary because the Metaverse will only be enriched by user-generated content if that content and data can be experienced and read across platforms.

5.2 Limitations and Future Research

Our study stands as an early attempt to shed light on the development of the Metaverse. The novelty of our work comes with limitations which we need to acknowledge. First, many of the participants of our study were part of more than one expert group, which means it was difficult to compare between groups of experts to gain a greater understanding of diverse opinions. Second, although we tried to diversify the insights of our study by recruiting participants from diverse groups, our findings are based on the expert views of eleven individuals, who are nonetheless heavily involved in the development of the Metaverse. As time goes on, and more individuals begin to be involved in the construction and expansion of the Metaverse,

these sectors may become more easily distinct allowing for a stronger comparative study, as well as the recruiting of more experts for providing future research endeavours with insights. Considering our position as an early attempt to further gain an understanding of the Metaverse architecture, there are numerous avenues for further research on the topic. For instance, within their responses, some participants differentiated between a 'user' and a 'consumer' within the Metaverse. This distinction remains unclear, especially when considering a Metaverse built upon blockchain technology which greatly facilitates the purchasing and transacting of digital assets. Concurrently, such a distinction offers opportunities for contribution to the discussions on the use of the term 'users' in the disciplinary ontology that has recently emerged in the IS literature (e.g., Markus, 2017). More specifically, the question worth investigating is whether all consumers of Metaverse products will be active users, whether all users will be consumers or whether users can engage with the Metaverse without needing to be a consumer. Future research may also need to be conducted considering regulation changes or drastic technological developments. Either could severely diverge the predictions laid out for the Metaverse in this study.

5.3 Conclusion

We sought to understand the evolution of the Metaverse architecture by investigating what it means to industry experts and addressing whether it would develop into a 'uni-verse' or a 'multi-verse'. The key findings of our study show that most industry experts see the Metaverse developing into an expansive 3D simulated reality that offered a large range of functionalities. A Metaverse of this scale naturally presents vast opportunities for users, as well as organizations. The participants of our study also agreed that the Metaverse would most likely take the form of a 'multi-verse', as defined in this study. A slightly greater point of contention was the issue of interoperability. The scale of interoperability within a Metaverse network would likely impact user experience greatly. It remains to be seen to what extent Metaverse platforms will endeavour to have their space incorporated into a standardized network that promotes interoperability.

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