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DODECAHEDRAL FRAMEWORK: a conceptual proposition for the analysis of the constituent elements of the Metaverse Experience Networks

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1) Introduction

In his book Snow Crash, published in 1992, science fiction author Neal Stephenson coined the term Metaverse to describe a futuristic scenario in which people take refuge in virtual worlds to escape social and environmental decay. In this dystopian vision, the Metaverse would be a way to preserve some sense of human dignity in the face of the collapse of material life.

However, in recent decades, the concept of the Metaverse has evolved and moved closer to reality, thanks to advances in the technologies of Virtual Reality (which creates a computerized representation of reality), Holography (which projects light to form three-dimensional images of real objects), Artificial Intelligence (which applies techniques to simulate the capabilities of intelligence in electronic devices) and Blockchain (which records and tracks transactions and assets on a digital network shared and unchanging).

Between the years 2021 and 2023, the term Metaverse gained prominence in a significant number of publications in the international press, all of them seeking to present this potentially disruptive technological development that is being introduced with fanfare by the largest technology conglomerates in the world, being pointed out by experts as a time frame for a new era of communications, that start to use the latest technologies, such as virtual reality and holography, to allow people to be inserted into three-dimensional, immersive and temporally persistent digital worlds (BARRERA, 2023).

However, there is still much confusion about what the Metaverse really is, what its difference is from the Networks of Experience that constitute it, and what the impact of all this is on people's everyday lives.

According to Ball (2022), the Metaverse is a network of 3D virtual universes that are created and updated in real time, that can be accessed simultaneously and permanently by a virtually unlimited number of users with a sense of individual presence, and that maintain the continuity of data, such as identity, history, rights, objects, communications and payments. Dincelli (2022), defines the Metaverse as a decentralized and persistent virtual universe, formed by immersive and emerging technologies such as blockchain, non-fungible tokens (NFTs), AI and Web 3.0, which results in unique properties for this environment, generating new disruptive paradigms for the way we work, do business, socialize and have access to forms of entertainment.

In the present article, Metaverse is conceptualized as a digital representation of the face-to-face physical world, made possible using virtual reality or holography devices, which allows the interaction of people in a very realistic three-dimensional virtual environment, enabling a greater immersiveness in the activities developed. In addition, because it is not subject to the limitations of the physical world, in the Metaverse there are no barriers of geographical space, chronological time, action of the force of gravity or inertia, which makes it possible to perform activities in simulated situations that would be impossible to be done in the physical world.

In this study, it is postulated that the Metaverse is formed by a set of Experience Networks, which offer several specific applications, such as digital games, spaces for coexistence and leisure, markets for buying and selling digital assets and spaces for relationships between commercial brands and their users. Experience Networks are virtual platforms created by companies to offer an immersive three-dimensional space where users can interact and participate in free or paid events and activities. The Metaverse is a technology that integrates these platforms, allowing users to access various digital services and applications from different

companies and organizations, as well as communicate with others in a three-dimensional environment.

To shed light on the relevant issue of the rise of Metaverse Experience Networks, in a context of increasing importance of the virtualization of production and economy, as well as the growth of digital marketing initiatives, the following research problem is proposed in this article**: how do the emerging Metaverse Experience Networks differ from the current Internet Social Networks in terms of characteristics and potentialities?**

Thus, the objective of this article is: **propose a conceptual framework that makes it possible to characterize the emerging Metaverse Experience Networks as a new object of academic study, different from the current Internet Social Networks and that succeeds them chronologically.**

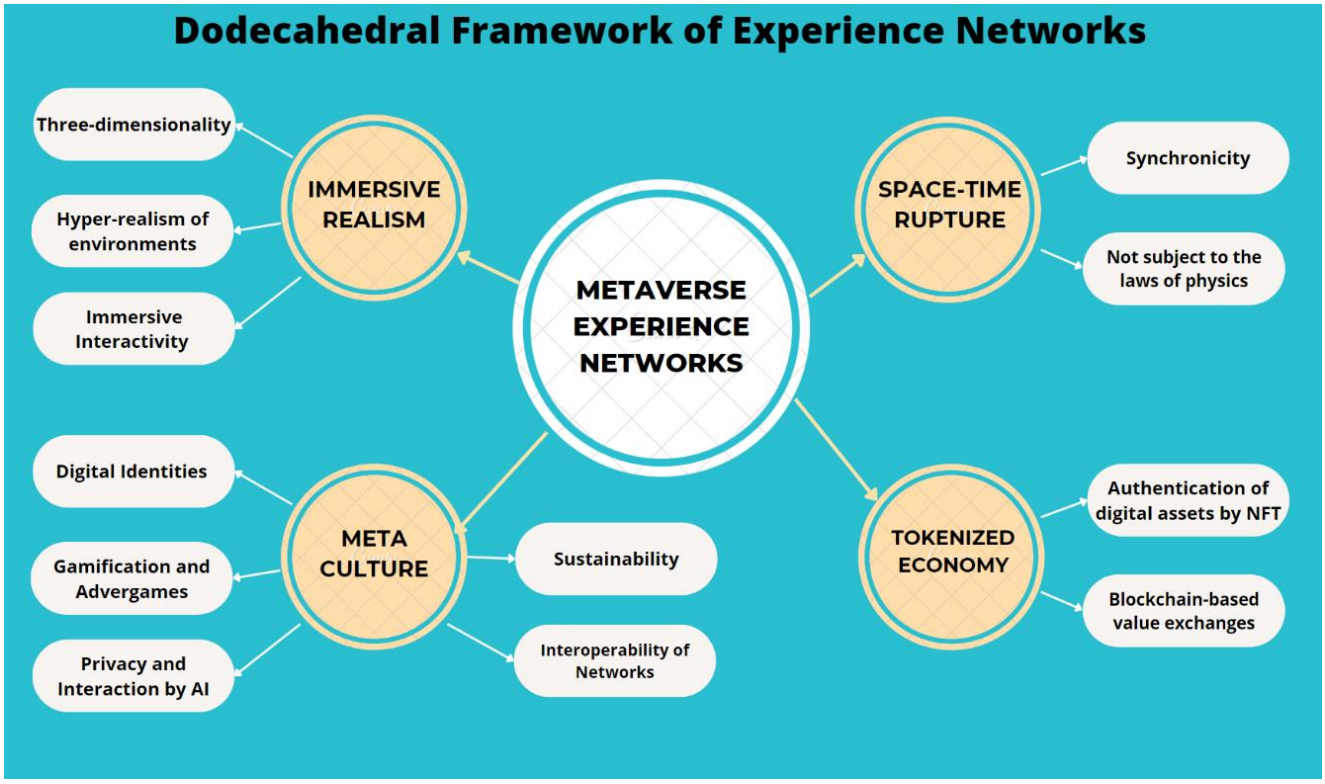
2) Development

To assist in the characterization of the emerging Metaverse Experience Networks, in addition to differentiating them from the current Social Networks, a conceptual framework is proposed to detail their main constituent dimensions, being called in this study the Dodecahedral Framework.

In addition, the Dodecahedral Framework can also be used as an analysis tool for the elaboration of questions, checklists and/or indicators to qualitatively evaluate or quantitatively measure the characteristics that must be considered by a brand that intends to act in the metaverse.

Inspired by the physical universe in person, which according to recent studies presents a geometric structure of dodecahedron (ELLIS, 2003), having twelve faces, the Digital Metaverse Experience Networks can be defined as being composed of a Dodecahedral Framework with 12 analysis variables, grouped into 4 dimensions.

Figure 01 – Dodecahedral Framework of Metaverse Experience Networks, presenting 4 dimensions and 12 analysis variables.



Immersive Realism Dimension

The Immersive Realism dimension seeks to portray the essentially virtual nature of the Metaverse Experience Networks, without however failing to point out that the main objective of these networks, as stated by their creators and managers, is the improvement of the virtual reality technologies employed, to make the representation of the environments as realistic and believable as possible, so that, In the near future, digital emulation will be practically indistinct from the face-to-face physical world, consequently generating a greater sense of familiarity, belonging and representativeness for its users. This dimension is composed of the following analysis variables:

1. Three-dimensionality – this variable allows the creation of three-dimensional environments and products that approach physical reality and that can be explored by users from different angles and perspectives. This can generate greater engagement, memorization, and preference.

2. Hyper-realism of environments (potentially indistinguishable from physical reality) – this variable makes it possible to offer experiences that are potentially indistinguishable from face-to-face reality, creating a sense of presence and immersion in users. This can increase trust, credibility and loyalty, favoring greater permanence in these environments.

3. Immersive interactivity (intrinsic protagonism, active participation with content and CUGE - collective user-generated experiences) – this variable allows to stimulate the intrinsic protagonism of users (active and collaborative conduct), who can actively interact with the content and with other users. In addition, the collective creation of experiences or digital assets (co-creation) can be encouraged, generating a sense of community and belonging.

Space-time Rupture Dimension

The Temporal Space Rupture dimension seeks to characterize the Metaverse Experience Networks as virtual environments in which both space and time do not flow following the same rules of the face-to-face physical world. In this sense, there are no limitations of physical space in the Experience Networks to accommodate all participating users, for example, a virtual show held in a digital twin stadium (fully reliable digital representation of a physical face-to-face location) can accommodate both ten thousand people and 10 million people, with a small effort to expand space via programming in the codes of the graphic engine used to generate the virtual environments, something that would be totally impossible to be materially feasible in the physical world.

That is, in the Metaverse there is no shortage of physical space, it is unlimited, and possible to be used in impractical environments in the physical world, such as the bottom of the oceans, the orbit of the Earth or even on other planets. There is also no gravity and inertia in Experience Networks, its users can fly, cross solid objects, instantly teleport to other environments and have no physical consequences of their actions, such as jumping from a 200-story virtual building and not getting hurt or dying.

The absence of limitations also applies to the passage of time, as one can speed up the day so that it becomes night, or the other way around, in addition to the fact that avatars do not age, unless that is the desire of their users, and can also live digitally forever, even after the death of their creators / users, Using emerging technologies of artificial emotional intelligence, with the use of neural networks, to reproduce the behavior, speeches and thoughts of their creators, interacting normally with family, friends or any other user after the death of the creator. This dimension is composed of the following analysis variables:

4. Synchronicity (real time driven) – this variable makes it possible to communicate with users in real time, responding to their demands and expectations in an agile and personalized way. This can generate greater satisfaction, loyalty, and positive recommendation.

5. Not-subject to the laws of physics (spatially unlimited, manipulable time, actions without physical consequences and fully customizable) – this variable allows to transcend the limits of space and time of the physical world, offering experiences that would not be possible in face-to-face reality. One can create spatially unlimited environments, speed up or rewind in perceived time, allow actions without physical consequences, and fully customize offers to users. This can generate greater surprise, enchantment and differentiation.

Meta Culture Dimension

The Meta Culture dimension discusses the great impacts that the immersive technology of the Metaverse Experience Networks will bring on everyday habits, such as studying, working, buying, investing, having fun and relating, and about how all this will impact, in a medium-term future, on the culture of hyper-connected postmodern societies.

In this sense, Meta Culture is a kind of chronological successor of Digital Culture, which began in the nineties of the last century, and is still in full phase of unfolding at the beginning of the 21st century. Differently from what happened with Digital Culture, which was impacted by the Internet, Social Networks, Smartphones and Digital Marketing, giving rise to social and cultural concepts such as Selfies, Memes, Cancellations, Stalkers, Haters and Fake News, Meta Culture will be impacted by the future Metaverse, Experience Networks, Virtual Reality Glasses and Immersive Marketing, with social and cultural impacts and developments yet to be observed and mapped as the future unfolds. This dimension is composed of the following analysis variables:

6. Digital Identities (personal representation by hyper-realistic Avatars) – this variable makes it possible to relate to users through hyper-realistic avatars, which represent their personalities, preferences and styles in the metaverse. You can create your own avatars or sponsor avatars of digital influencers, generating greater identification, affinity and admiration.

7. Gamification and Advergames – this variable allows you to incorporate playful elements into the communication and immersive marketing strategies in the Metaverse Experience Networks, such as rules, route scripts, individual challenges, collective competitions, rewards and rankings. Own games can be created or personalized playful spaces inserted in existing games, generating greater fun, motivation and collective participation of users.

8. Privacy and interaction mediated by Artificial Intelligence according to rules of conduct – this variable makes it possible to protect the personal data of users of the Metaverse Experience Networks, respecting their choices and consents. In addition, artificial intelligence can be used to mediate interactions between users and between them and brands/products, following ethical and transparent rules of conduct. This can generate greater security, trust and respect on the part of users. Artificial intelligence can also be used to generate content tailored to users' interests and needs, to provide customer support and service, to generate insights and recommendations, and to optimize immersive marketing strategies.

9. Sustainability (lower production cost, elimination of environmental impacts and reduction of carbon footprint) – this variable allows to reduce the production costs and the environmental impacts of the activities conducted in the Metaverse Experience Networks, contributing to the sustainable development of the planet. Acting in these networks can reduce the use of natural resources and polluting materials, reduce the emission of greenhouse gases and offset the carbon footprint. This can generate greater awareness, responsibility and

appreciation on the part of users, acting as a driver of Social Marketing initiatives and corporate ESG agenda.

10. Interoperability of Experience Networks (possibility of transporting digital identities, digital assets, and creations to any participating network) – this variable refers to the possibility of transporting digital identities, digital assets, and virtual creations to any Metaverse participating Experience Network. This means that users can access different experiences with the same identity and take with them their digital goods such as avatars, clothes, NFTs, accessories and objects.

Tokenized Economy Dimension

Finally, the Tokenized Economy dimension seeks to portray the future economic and financial impacts that Blockchain, Cryptocurrencies, NFTs, Smart Contracts (smart contracts) and Decentralized Finances (Defi), integral parts of the Metaverse Experience Networks, will have on the economic order and the global financial system, in addition to their more immediate impacts on the modalities of value exchanges and acquisitions of digital assets by the users of these networks. This dimension is composed of the following analysis variables:

11. Personal and digital asset authentication performed by non-fungible tokens (NFT) (unique encrypted codes of authenticity that utilize Blockchain technology) – this variable enables the use of unique encrypted codes of authenticity that utilize Blockchain technology to ensure the ownership and originality of digital assets in the Metaverse Experience Networks.

NFTs allow users to create, buy, sell, and collect unique and verifiable digital assets such as artwork, music, videos, games, among others (CLARK, 2021).

12. Monetization/value exchanges based on Cryptocurrencies that use Blockchain technology – this variable enables the use of payment and value transfer mechanisms that use decentralized and secure cryptocurrencies in the Metaverse Experience Networks.

Cryptocurrencies allow users to carry out financial transactions without intermediaries or fees, as well as enabling the creation of new business models and the sharing economy in the Metaverse (CLARK, 2021).

Next, each of the 12 analysis variables proposed in the Dodecahedral Framework of Metaverse Experience Networks will be explained in detail.

2.1) Three-dimensionality (Immersive Realism Dimension)

With the Metaverse Experience Networks, access to digital content through "screens", which began in the last decades of the twentieth century, with the advent of the World Wide Web (graphic environment of the Internet), is now done through glasses with holographic technology (mixed reality) or that use optical mechanisms of totally virtual projection (virtual reality). The progressive abandonment of screens in favor of glasses or lenses, which project images and simulations directly onto the retina, presents some advantages for interaction with digital content.

The first, and most obvious, is the release of the hands, which will no longer need to be holding the device with a screen (be it a smartphone, a tablet or a notebook), being free to manipulate the content or perform any other activity. Another advantage is that it is no longer limited to the size of the screen to present the content, as the projection of the images onto the retina allows the entire main viewing space, with an angle of 180 degrees and extension of the hands extended laterally, to be used to present the content, further expanding the viewing space and interaction with it.

In addition, the digital representation goes from 2D (two-dimensional - length and width) to 3D (three-dimensional - length, width and depth), enabling the development of simulations of environments and people more realistic, reliable and immersive (LOUREIRO, 2019).

For the characteristic of the Three-dimensionality of the Experience Networks to take shape, it was necessary to develop specialized computer programs in the creation of three-dimensional environments, the so-called Graphic Engines, which allow the digital simulation of any environment seen in the face-to-face world, in addition to the possibility of generating fantastic scenarios never seen. One of the main Graphics Engines currently used is the Unreal Engine (https://www.unrealengine.com/en-US/), developed by the company Epic Games, and widely used by the world's leading developers of digital games, special effects for cinema and applications of digital architecture of high complexity.

Unreal Engine provides a virtualized geometry system that allows you to create games and digital worlds with substantial amounts of geometric detail. It also includes global lighting system and fully dynamic reflections, designed for state-of-the-art applications in digital architecture, creating solar lighting patterns and shadows like those seen in the real world.

This graphics engine also greatly simplifies the process of creating digital worlds of great extent and complexity, changing the way levels of graphic detail are managed and transmitted, automatically dividing the digital world into a grid, and transmitting the cells needed to convey the realism of the scenarios. With the applications of Unreal Engine, it is possible to create in a few hours a very realistic large-scale interaction environment, with diverse and dynamic scenarios, favoring the immersiveness of the participants of the Experience Networks

2.2) Hyper-realism of environments (Immersive Realism Dimension)

The rapid technological evolution of holographic projection and virtual reality devices, coupled with the improvement of graphics engines in the ability to create hyper-realistic virtual worlds with accurate richness of detail, will contribute to, in a span of a generation (about 20 years), potentially create a Metaverse that is practically indistinct from the physical world where we were born, and which we have always been accustomed to dealing with. When that moment comes, the boundaries between face-to-face and virtual reality will become quite tenuous and unimportant, as the two environments of living and experimenting will be so integrated that they will function as a single plan for the unfolding of the human experience.

A concrete example of this ongoing process is the technology called Digital Twins, which is one that creates a virtual replication of an object of the physical world, reflecting not only its appearance, but also its internal processes of functioning and its performance, in an identical way to what happens concretely in the face-to-face environment. By enabling an early view of the mirrored object virtually, the use of digital twins contributes to the reduction of production/maintenance costs, improves the safety of processes that involve operational risk, increases the efficiency of products or production systems and creates new business opportunities (ACCENTURE, 2021).

Recently, English football team Manchester City announced a partnership with imaging technology company Hawk-Eye, a subsidiary of Sony, to develop a Digital Twin of its football stadium, the Etihad Stadium. According to team directors, "it would be possible to reproduce a virtual experience very similar to the real one. One of the advantages of the model is to see games from different angles, with ambient sound and cheering chants, in addition, there would be no limitation of public or concern for the physical safety of people, since everything will be 100% virtualized, being a way to avoid the closure of stadiums, and the consequent drop in revenue, in situations similar to pandemics" (CANALTECH, 2022).

In this future scenario described, the economy, the world of work, entrepreneurship, communication, and forms of leisure and learning, will be profoundly distinct from what we have today, as the digital functionalities of the Metaverse will add entirely new forms of business development, valuation of virtual assets, creation of digital products, acceleration of

teaching/learning, temporal and spatial flexibility of work, as well as a multitude of new forms of leisure and communication.

With this possibility of using the new technologies of virtual and extended communication to reliably mirror the physical world, the metaverse can offer new forms of access, production and consumption of information, which are more dynamic, interactive and personalized. For example, users could explore diverse sources of information in the same virtual space, compare data and opinions, create collaborative content and share their experiences with other users. In addition, the metaverse could provide a greater immersion and engagement of users with the information, by allowing them to experience simulated or real situations in the first person, with a high degree of realism and sense of presence.

The metaverse can also influence how users relate to each other and to the brands that operate in this environment. On the one hand, the metaverse can favor the creation of virtual communities based on common interests, shared values, and cultural identities. Users could communicate more expressively and authentically, using avatars that reflect their personality and preferences (UDDIN, 2023). On the other hand, the metaverse can generate new challenges and risks to the privacy, security and ethics of users, who may be exposed to false, manipulated or offensive content, as well as to abusive or illegal practices of collection and use of personal data.

In this way, the metaverse can represent an opportunity for brands that develop relationship actions in these virtual environments. Brands could harness the potential of the metaverse to create unique and memorable experiences for their customers that involve entertainment, education and excitement. Brands could also establish a more direct and personalized communication with their target audiences, offering customized solutions and valuing user feedback. However, brands should also be attentive to the expectations and needs of users in the metaverse, respecting their privacy, their autonomy, and their diversity.

2.3) Immersive Interactivity (Immersive Realism Dimension)

The activities in the Experience Networks occur in synchronous time mode, that is, in real time, with the avatars relating to each other and, through an immersive interactivity, participating in the collective experiences or exercising the co-creation of some digital product/object. Thus, unlike what occurs in Social Networks, where a user can passively observe for a long time content of photos and videos posted, the environment of the Experience Networks does not favor such passivity, because if there are no such activities collectively performed, in fact there will not be an effective participation in the experiences of these networks.

To this necessary active participation of the users of the Experience Networks, for the creation of collectively generated experiences, we will call in this study "Intrinsic Protagonism", which constitutes an inherent characteristic of the digital environments of these networks. This characteristic is an essential condition for the development of immersive digital experiences, whether they are created by the users themselves, by the companies providing the Experience Networks or by the partner brands of these networks.

This concept is directly related to the adoption of new marketing practices in Experience Networks, which we call in this study Immersive Marketing, and which has as one of its main tools of action the collective user-generated experiences (CUGE), which replace the traditional forms of digital engagement of Social Networks (post, tag, like, comment and share), by new forms of relationship between brands and consumers, providing them with unique immersive digital experiences, conducted collectively and that establish a potentially more intense and lasting emotional bond, helping to maintain their loyalty and increase the acquisition of new products/services based on digital assets (COWAN, 2019).

2.4) Synchronicity (Space-time Rupture Dimension)

The characteristic of synchronicity gives the Experience Networks a character of interactivity that occurs in real time, going far beyond the asynchronous interactions characteristic of Social Networks, which merely allow to like, comment or share content that was produced at some point in the past. This fact allows the Experience Networks to promote a more intense, lasting and participatory type of bond, allowing, for example, the participation in experiences promoted by brands or other participants, as well as the co-creation of content by users in real time.

The synchronicity, which was made possible by the technological evolution of the means of communication (advent of fixed broadband internet and mobile 4G/5G), allows us to enter a new level of digital relationship between people, abandoning two-dimensional screens and entering the new world of relationships between realistic avatars, in vast three-dimensional virtual worlds and with unlimited possibilities of action. This characteristic enables the development of new Marketing practices, which we call in this study Immersive Marketing, taking advantage of the benefits of synchrony for marketing communication and brand relationship management, and whose characteristics will be better detailed in a specific chapter.

Another direct consequence of synchronicity is the evolution of the concept of engagement of Social Networks, consisting of the asynchronous actions of posting, tagging, liking, commenting and sharing, to a synchronous process of experience, consisting of more lasting actions that occur in real time, carried out cooperatively by users and with varied objectives. This evolution of the digital relationship, from the asynchronous phase of engagement to the synchronous phase of experience, is precisely the preponderant characteristic that justifies the development of the concept of Experience Networks, differentiating them from Social Networks, where engagement is the only form of interaction made possible by its technology.

In this way, the impacts on the digital experience of the user in the Experience Networks are enormous compared to those that he obtains in the Social Networks, because he will be able to replicate virtually all the activities that he performs in the face-to-face physical world, such as working, shopping, studying, having sex, having access to varied leisure options, creating a wide variety of objects and digital properties, among numerous other possible actions (BALL, 2022).

2.5) Not subject to the laws of physics (Space-time Rupture Dimension)

Although the goal of Metaverse Experience Networks is to virtually replicate the face-to-face physical world, because of the characteristics of its constituent technologies, its users are not subject to the laws of physics, such as gravity and inertia, nor to spatial limitations. This means that they have the power to accomplish things impossible in the face-to-face physical world, such as flying, teleporting to any virtual destination, falling from high heights and swimming at great depths without dying and visiting places inaccessible in person. In addition, the space available for buildings is unlimited, without problems of environmental degradation and customizable according to personal interests.

Such characteristics reinforce the unlimited possibilities of developing unique experiences that the Metaverse provides because users, companies, providers of digital platforms, as well as any other agents, can develop forms of collective participation with unprecedented and non-replicable interaction resources in the face-to-face physical world (CHEAH, 2023).

One of the possibilities that Metaverse Experience Networks offer is to break through the limitations of the laws of physics, such as gravity, inertia, space, and time, which govern the physical world. This can make it possible to offer new forms of interactivity and digital products/services to the users of these networks, who could experience impossible or improbable sensations and situations in physical reality.

For example, users, represented virtually by their avatars, could fly, teleport, shapeshift, manipulate objects with thought, create custom worlds, participate in immersive games, watch 3D shows and movies, among other activities. These experiences could generate greater engagement, fun, creativity, and learning for users.

In addition, Metaverse Experience Networks can alter users' perception and level of engagement with the brands they operate. Brands could harness the potential of the metaverse to create more interactive, personalized, and engaging advertising campaigns that would allow users to experience brands' products and services in a more realistic and emotional way.

Brands could also explore new formats and channels of communication with users, such as sponsoring virtual events, creating exclusive stores and spaces in the metaverse, offering digital rewards and benefits, among other strategies. These actions could increase users' visibility, reputation, loyalty, and preference for brands in the Metaverse Experience Networks.

2.6) Digital Identities (Meta Culture Dimension)

We turn to the definition of Avatar provided by Miao et al, that they are "digital entities with anthropomorphic appearance, controlled by a human or by software, which have the ability to interact with people" (MIAO et al, 2021). Along these lines, the authors developed a classification matrix with four quadrants to frame the several types of avatars developed within the environments of the Metaverse Experience Networks.

The classification matrix proposed by Miao et al, presents two axes, Form Realism and Behavioral Realism, both subdivided into two performance ranges, Low and High, translating respectively the levels of realism of the avatars in the reproduction of the human form and behavioral responsiveness. Form Realism refers to the extent to which the avatar's form appears human, including design elements such as spatial dimension (2D/3D), movement (static vs. dynamic), and human characteristics (e.g., name, gender). Behavioral Realism captures the degree to which he behaves like a real human of the physical world, including the avatar's mode of communication (e.g., verbal, facial, gestural), the type of response (scripted vs. natural response), and the ability to interact in varied social context situations (MIAO and al, 2021).

The crossing of the axes of the matrix presents four quadrants of classification, Simplistic Avatar (low in form and low in behavioral), Unrealistic Intelligent Avatar (low in form and high in behavioral), Superficial Avatar (high in form and low in behavioral) and Digital Human Avatar (high in shape and high in behavioral). According to the conclusions of the studies by Miao et al, the Simplistic Avatar presents the most rudimentary simulation capacity, attracting little interest and expectation from people, due to its low performances in appearing human and interacting in natural language in varied situations with humans. The Digital Human Avatar, also called the Human Meta, has the most sophisticated simulation capacity of classification, attracting great interest and expectation from people, for its high performances in appearing human and interacting in natural language in varied situations with humans (MIAO et al, 2021).

The empirical findings observed in this research, which resulted in the classification matrix of the avatars of the Experience Networks, are in full line with the efforts made public by the main companies developing technologies for the Metaverse, such as Meta, Microsoft, Epic Games and Nvidia, which have disclosed in their reports to investors that they are allocating considerable investments to make the avatars and virtual scenarios as realistic as possible, to become more attractive and engaging to users (BALL, 2022).

A very promising application of the Unreal Engine for Metaverse Experience Networks is the development of "Meta Humans", which are the next generation of Avatars to represent the users of these networks. Metahumans are hyper-realistic depictions of people, with the ability to simulate all human aspects related to body, skin tone, eyes, hair, and face, including the ability to demonstrate facial expressions that reflect emotions.

The Unreal Engine allows you to choose the Meta Human that best reflects the user's real or desired appearance, from a wide range of pre-configured options, or use an intuitive authoring tool to create a Meta Human in a personalized way.

The possibility of the users of the Experience Networks to represent themselves in a more realistic and reliable way increases the empathy of their interactions with other users within the networks, contributing to make them more comfortable in this simulated environment, in addition to favoring a greater immersiveness in the activities developed in the digital environments.

Another very interesting application for Meta Humans is to make them digital personal assistants within the environments of the Experience Networks, functioning as hosts of the users, teaching the way the network works, its functionalities, rules of conduct in the interaction, privacy modes, in addition to being always available to be called to assist in doubts related to the virtual environment. In this application, the Metahumans would not have people being represented by them, not acting as Avatars, but would be commanded by artificial intelligence algorithms, learning from their own doubts, comments and reactions of the users, and being coordinated by the central operating system of the experience network.

In this way, the use of Meta Humans as tools to support users, in addition to providing instant service in an empathetic way, will also constitute a powerful source of information to subsidize future improvements in the functionalities of Experience Networks.

2.7) Gamification and Advergames (Meta Culture Dimension)

The Metaverse Experience Networks should not be limited to the concept of Games (virtual games), since they do not necessarily present the characteristics that define them: existence of a defined objective for the activity, progression in successive phases and existence of a delimited end. Thus, although Experience Networks do not necessarily fit the concept of games, they tend to be developed as Gamified Spaces (virtual spaces where playful activities are prioritized to promote interaction and co-creation) for their users. However, there is evidence that enables the connection of the gaming public to the group of users that constitute the pioneers in the use of Experience Networks and the Metaverse (BHATTACHARYA et all, 2023).

This inherent characteristic of Experience Networks favors their application to promotional activities of brands based on Advergames. Advergames are games that promote brands, products or services and can be a useful tool for brand communication in the Metaverse. They are a form of interactive advertising and can be an effective strategy for brand communication in immersive digital environments of the Metaverse, as they provide a fun and engaging experience for users, increasing brand recall and association with positive feelings (WONGKITRUNGRUENG, 2023).

Advergames allow you to create spaces of virtual brand-consumer interaction with a spatial scope and a wealth of details that would be very difficult to be reproduced in the physical world in person, as well as prohibitively expensive.

Advergames can take brand-consumer interaction to another level by creating experiences experienced in virtual worlds that potentially generate more intense and lasting emotional effects, reinforcing the bonds established with preferred brands (XI, 2020). An interesting

example of the application of Advergames for the promotional actions of brands is the case of the Cidade Alta Experience Network.

Cidade Alta (https://cidadealta.gg/) is a Brazilian server of the virtual game GTA 5 RP launched in February 2020, when the companies Outplay and Loud signed a partnership. This virtual environment simulates a hyper-realistic face-to-face city, with streets, buildings, shops, bars, restaurants and shopping centers, as well as means of locomotion, such as cars, motorcycles, bicycles, boats and helicopters.

Within its environments, various virtual events and marketing actions are often promoted with partner brands, such as Ifood, Brahma, Banco Itaú, Banco do Brasil, Jeep, Outback, Tinder, Engov and Logitech.

Brahma marked the opening of its bar in Cidade Alta with the launch of the long neck version of its Double Malt beer. The virtual bar will serve as a meeting point for users of the Experience Network, with the brand also promoting special missions, such as loading a truck from Brahma to distribute beer to various parts of the city. Players who complete the missions within the Upper City can earn discount coupons to secure a Double Malt Brahma by iFood directly in their homes.

2.8) Privacy and interaction mediated by Artificial Intelligence according to rules of conduct (Meta Culture Dimension)

According to the Watson Artificial Intelligence Laboratory of MIT and IBM (https://mitibmwatsonailab.mit.edu/), one can conceptualize Intelligence as the ability to perceive variables, identify patterns, make decisions and solve problems. Also, according to this research institution, Artificial Intelligence (AI) – "is the development of a set of techniques and technologies to emulate the faculties of intelligence in electronic devices, allowing them to function in a way that resembles human thought" (MIT-IBM, 2021).

In this way, AI was developed to help humans make decisions and solve complex problems in a faster and more automated way, including having the ability to learn on their own and act without the intervention of people supervising. This autonomous learning capability of AI has been called Machine Learning, being conceptualized as "the use and development of computational systems that are able to learn and adapt without following explicit instructions, using algorithms and statistical models to analyze and make inferences from data patterns" (MIT-IBM, 2021).

The main applications of Machine Learning are: Improve customer behavioral segmentations; Predict the lifetime value of a customer; Product recommendations based on historical and profile analysis; Dynamic pricing; Programmatic advertising in social networks; Automation of marketing campaigns; Improve the consumer journey; Development of customized products (CUKIER, 2020).

In this sense, according to the studies of De Bruyn (2020), the ability to transfer the tacit knowledge of human beings (such as that demonstrated by marketing experts and sales consultants), to machines endowed with artificial intelligence, will be something fundamental to create new products, services, solutions and relationships in a future context in which society becomes increasingly hyperconnected and digital technology begins to play a central role. In turn, also being able to transfer back what the machine has "learned" in its relationship with the various experts will be key to identifying biases and errors, encouraging humans to place greater trust in AI machines, and accepting their decisions with greater conviction.

Another technology essential to the advancement of AI is so-called Computer Vision, which can be conceptualized as "a field of artificial intelligence (AI) that allows computers and systems to obtain meaningful information from digital images, videos, and other visual inputs, and to take actions or make recommendations based on that information" (MIT-IBM, 2021).

Computer Vision uses image processing algorithms, neural networks, and machine learning to perform operations that the human brain and vision can perform, such as recognizing and categorizing objects, identifying patterns, identifying emotions, detecting faults, or quality control.

The main applications of Computer Vision are: Driving autonomous vehicles; Identification of diseases in examinations; Create "artificial eyes" for blind people; Facial recognition; Security surveillance; Identification of emotions (IEA); Virtual fitting room technology to help customers see what clothes look like without wearing them; Social media trend surveys (PUNTONI, 2021).

In recent years, due to developments in the fields of Machine Learning and Computer Vision, AI technology has been perfected to be able to recognize human emotions and predict mental states, allowing them to be identified through facial expressions, identification of eye and head movement, heartbeat measurement, tone of voice and gesticulation. This technological evolution of AI is called Artificial Emotional Intelligence (IEA), and can be conceptualized as "the development of systems that can recognize, interpret, process, and simulate human feelings and emotions" (MIT-IBM, 2021). The main applications of the IEA are: Measuring customer satisfaction; Evaluate feelings towards campaigns; Obtain emotional profiles to guide care; Analyze brand sentiment in social networks; Guide sales arguments and service scripts according to the emotional state.

Metaverse Experience Networks use these recent advances in AI and IEA technologies to mediate the interaction of their users in immersive digital environments, as well as define privacy assurance mechanisms based on explicit and non-negotiable rules of conduct.

AI and IEA are also applied to instant user support through virtual assistants, materialized as avatars in the three-dimensional virtual environments of Experience Networks. These wizards can help you understand and operate the functions available on the network; find information, locations, and users; mediate issues related to interaction between users; apply privacy assurance measures and constantly function as facilitators of the experience of users in their journeys through the immersive environments of the Experience Networks.

The company Meta (https://about.facebook.com/br/meta/), formerly known as Facebook, is working on a new class of AI models called Builder Bot that will enable the generation of virtual worlds based on descriptions made by people. This AI can recognize users' voice commands and create what they want to have in their virtual spaces, such as adding furniture and decorations in a virtual living room to receive friends.

Meta considers that users of Experience Networks will interact in the Metaverse through voice commands, so it is investing in AI research to allow people to have more natural conversations with digital assistants, which are being developed with advanced neural network algorithms and deep learning, that will enable them to interact with people in natural language (as they are spoken in everyday life), as well as allow a universal speech translator, to provide real-time translations of all languages, which would allow to connect users from any part of the world (FACEBOOK AI LAB, 2022).

In addition, concerns about the preservation of the privacy of personal data and the blocking of any attempts to clone this data, are measures that should be on the radar of companies promoting Experience Networks, with the development of high standard encryption (military level) and strict security protocols and validation of identities to ensure the tranquility of their users.

2.9) Sustainability (Meta Culture Dimension)

Sustainability is an inherent characteristic of Metaverse Experience Networks because they do not require physical raw materials to be built, unlike structures such as buildings,

auditoriums, promotional stands at fairs, billboards, busdoors or other external communication artifacts. For its operation, they only need servers for information processing, datacenters for the secure storage of data and energy generated in current sources for all this to work.

The metaverse could offer significant environmental benefits by replacing many physical products with digital ones, reducing the need for physical travel and construction with virtual alternatives, enhancing the optimization of the physical world with digital twins, enabling simulations to be conducted in cyberspace rather than material space, and fostering greater awareness and more effective action against global challenges, such as climate change (JAUHIAINEN, 2023).

Because of this fact, for example, the assembly of a large musical event, such as a concert by singer Ariana Grande, in an Experience Network such as Fortnite, consumes much less physical resources than if it were held in a physical stadium such as Allianz Parque in São Paulo, although it can hold a number of participants tens of times higher. This fact is consistent with the popularization and increase of the social and corporate importance of the concept of ESG (Environmental, Social and Governance, which in Portuguese can be translated to Environmental, Social and Governance), where the aspect of sustainability has gained prominence and contributes to the creation of value of a brand.

The ability to serve an immense number of users simultaneously, in the tens of millions of people, with a significant reduction in the consumption of physical resources, with the elimination of environmental impacts and the consequent reduction of the carbon footprint in the production process, are inherent characteristics of the technology that promotes the operation of the Metaverse Experience Networks.

The expression "Carbon Footprint" is derived from the English language Carbon Footprint and refers to the calculation of the total emission of greenhouse gases (GHGs), including carbon dioxide (CO2) and methane (CH4), associated with human activities on the planet. A series of indicators, ranging from food, to how much you use the car or other transport will measure the calculations of your carbon footprint, which indicates the amount of greenhouse gases emitted in your day to day, which are considered carbon equivalent (VICENZO, 2021).

In convergence with these efforts, it is perceived that the progressive virtualization of productive activities and consumption of products/services, in which the expansion of Metaverse applications is one of the exponents, contributes significantly to the progressive reduction of the carbon footprint in the coming decades.

The progressive performance of brands in the virtual networks of the Metaverse can help in sustainability in several ways. Some of the advantages of the Metaverse for sustainability are:

i. Replacing physical goods with digital and virtual alternatives, such as clothing, accessories, furniture, and even travel, can reduce the consumption of natural resources, the generation of waste, and the carbon emissions associated with the production, transportation, and disposal of these goods.

The use of the Metaverse for educational, professional and social purposes can decrease the need for physical displacement, which also contributes to energy savings and the reduction of air and noise pollution.

The creation of digital twins, which are virtual replicas of real objects, systems or environments, can facilitate the simulation, monitoring and optimization of processes and operations that involve the use of natural resources, such as water, energy and waste management.

The application of the Metaverse to urban planning and design can enable the testing and evaluation of different scenarios and solutions to sustainability challenges in cities, such as mobility, housing, infrastructure, and climate.

2.10) Interoperability of Experience Networks (Meta Culture Dimension)

This point concerns the establishment of technical standards (technologies, protocols and programming languages) that are mutually compatible and allow the interconnection of the various Experience Networks currently existing, in addition to those that may be developed in the future. This compatibility will allow the interoperability of the different networks, something that does not yet exist, allowing us to have in the near future the true concept of the Metaverse in operation, and not a collection of Experience Networks that operate distinctly, each with its different technological standard, without enabling the integration, convergence of its applications and portability of assets, digital creations and identities (METAVERSE STANDARDS FORUM, 2023).

To illustrate the current state of technological disconnection, let us imagine a shopping center as the Metaverse, being composed of several stores specialized in some product/service, which would be the Experience Networks.

In a shopping mall in the physical/face-to-face world, we can buy shoes in a specific store, shirts and jackets in another location, caps in one more place and, finally, portable electronics in a last specialized store. After all these purchases have been made, we can circulate in all environments of the mall dressed in the clothes/shoes and using the electronics purchased, and they will be accepted and will work perfectly in all environments of the physical/face-to-face shopping center.

Well, currently, in the embryo of the Metaverse, it does not work that way. The creations we develop and the digital assets we acquire in one Experience Network are not accepted and will not work on another of these networks. Similarly, avatars that are carefully created and dressed in one location, will not be accepted in another network, as they have not yet interconnected their technical standards, not allowing the portability of virtual identities, digital assets and creations to any participating network.

That is, without the interconnection of technical standards, we do not have today a true Metaverse in operation, but a growing constellation of Experience Networks with innovative environments, products and services that, due to the lack of possibility of portability of avatars and digital assets, limit the experience of users only to their internal environments.

However, this current state of non-compatible networks is not interesting for the technology companies promoting the Experience Networks, which would have a higher possibility of revenue with the interchangeability of creations and digital assets between all participants of the Metaverse, as well as the possibility of developing interconnected cryptocurrencies in a common digital exchange system. Likewise, the interest and participation of users in Experience Networks would be enhanced with the possibility of portability of identities and digital assets.

These facts contribute to the existence of an intense and coordinated movement to establish common technical standards for the various Metaverse Experience Networks, materialized by the creation, in June 2022, of the Metaverse Standards Forum (https://metaverse-standards.org/), a global consortium formed by relevant companies in the areas of hardware, software, games, virtual reality and graphics engines, with major technological players such as Adobe, Autodesk, Meta, Microsoft, Google, Intel, Huawei, Tencent, Samsung, LG, Lenovo, Nvidia, Epic Games and Unity, among others, working to establish a technological standard of interconnection of the various Metaverse Experience Networks, in the same way that was done with the Internet, in its first moments in the 90s, with the establishment of the technical standards and protocols of IP (internet protocol) and HTML5 (for the creation and delivery of visual and multimedia content on websites) (METAVERSE STANDARDS FORUM, 2023).

The Metaverse Standards Forum anticipates the completion of the first stage of the work of standardization and establishment of interoperability protocols of the Metaverse Experience Networks by the year 2024, with further improvements being conducted annually until the end of the decade, to deal with the technological challenges of: synthesized visual reality; universally portable 3D assets; practical XR optics; real-time verification and semantics of the environment; end-user 3D content creation tools; precise physical simulations; realistic avatars; online personas and social connections; machine learning for real-time semantic understanding and assisted content creation; identity, security and privacy of the user; effective remote social interactions; streaming vast geospatial data sets; geo-anchoring the real world with persistence; IOT sensor networks; universal digital twins; scalability of servers that support three-dimensional content for millions of concurrent users; interoperable runtimes; tokenized economy and cryptocurrencies (METAVERSE STANDARDS FORUM, 2023).

According to the digital magazine specializing in technology Techmonitor, many of the initial results of the working groups of the Metaverse Standards Forum indicate that blockchain could be the answer to identity management in the Metaverse, which will become, over time, a decentralized process through the use of artificial intelligence and deep learning models, which can analyze identity in real time. and verify that it is authentic. It is also a very secure and transparent method as it links any transactions or interactions where identification is required to a traceable record on the blockchain. This will allow the portability of cryptocurrencies, identities and all kinds of digital assets on any Metaverse network (TECHMONITOR, 2022).

However, as researcher Ball (2021) points out, we are still in the embryonic phase of defining technological standards, and the complete vision of the Metaverse is decades away, requiring extraordinary technical advances, such as producing shared and persistent simulations in which millions of users synchronize in real time, as well as requiring revisions in business strategies and changes in consumer behavior.

2.11) Personal and digital asset authentication performed by non-fungible tokens (Tokenized Economy Dimension)

Non-fungible tokens (NFTs), non-fungible tokens in Portuguese, originally emerged in 2014, having been created by American artist Kevin McCoy, who sold a digital work called "Quantum," with an encrypted authenticity code embedded through blockchain technology. However, it was only from 2017 that the acronym NFT emerged, referring to unique digital assets, with certificates of authenticity and ownership issued through an encrypted blockchain network, with the aim of ensuring the originality of digital content and facilitating its commercialization (MACKENZIE, 2021).

Thus, NFTs are non-fungible assets, that is, assets that cannot be replaced by another without loss of value, since there is no direct value equivalence between them. Generally, NFTs represent intellectual capital assets, such as photos, music, images and digitized arts in general, which are the fruit of the creative work of their authors and are therefore unique, irreplaceable and of personalized value (CLARK, 2021).

To guarantee authors the right of intellectual property over their works, even if they are digital, and without restricting their free dissemination on the internet, they are transformed into NFTs by a process called tokenization, which encrypts the digital files of these works and writes their codes on a blockchain network, generating unique encrypted codes of authenticity and ownership. Much of the available NFTs are recorded on the Ethereum (https://ethereum.org/pt-br/) blockchain network, offering so-called "smart contracts," self-executing electronic agreements that host the NFT, and all the rules about its use (NADINI, 2021).

NFTs can be sold, exchanged or donated freely, giving rise to Marketplaces that specialize in enabling these transactions between creators and owners around the world. The Marketplace

with the highest number of transactions and users in the world in 2022 is Open Sea (https://opensea.io/), connecting more than one million registered users.

In addition, NFTs can confer license rights to use the associated asset for a specific purpose, which can generate new sources of revenue and engagement for brands. For example, a brand can create an NFT of a garment or an accessory that can be used across different Metaverse Experience Networks, creating a unique and personalized digital identity for the consumer. NFTs can also be traded and sold on digital marketplaces, which can increase the exposure and value of brands in the Metaverse.

2.12) Monetization/value exchanges based on Cryptocurrencies that use Blockchain technology (Tokenized Economy Dimension)

The emergence and expansion of Metaverse Experience Networks has boosted the use of so-called cryptocurrencies, which are digital currencies hosted on a blockchain network. The blockchain is a decentralized system that records all operations carried out with cryptocurrencies, without the need for intermediaries such as banks or governments. This ensures that the information is immutable, verifiable, and accessible by all network participants.

The world's first cryptocurrency, Bitcoin, was created in 2008, with the goal of being a new fully peer-to-peer electronic money system (it is a network architecture that allows the sharing of services and data without the need for a central server), decentralized and not regulated by governments and/or companies. Bitcoin has its own coding algorithm for the creation of its cryptocurrencies, which is one of the precursors of the concept of blockchain.

Since 2008, the use and appreciation of Bitcoin has taken a leap, helping to popularize the concept of cryptocurrencies and giving rise to dozens of new digital currencies. Such currencies have become one of the most widely used means of payment in transactions involving NFTs, also being adopted as safe options for financial transactions by people, companies and even governments (ZELENYANSZKI, 2023).

According to research conducted by Forbes Magazine in May 2023, the top five cryptocurrencies in terms of market cap were Bitcoin (BTC), Ethereum (ETH), Tether (USDT), Binance Coin (BNB), and U.S. Dollar Coin (USDC). All of them with their own quotations in relation to the US Dollar, Euro, Libra and other international physical currencies (FORBES, 2023).

The spread of cryptocurrencies as a way to transact value on digital networks has not gone unnoticed by the governments and central banks of the countries holding the world's largest economies. Many countries are already in the process of developing a Central Bank Digital Currency (CBDC), constituting a digital version of the country's official currency, issued and guaranteed by the Central Bank of that country.

In January 2022, China launched its CBDC digital currency, based on the concept of cryptocurrencies, the Digital Renminbi. The U.S., through President Joe Biden's executive order on digital assets, signed on March 9, 2022, has urgently begun the process of researching and developing a potential CBDC for U.S. business interests (BACEN, 2021).

Following the same path as other sophisticated economies, the Central Bank of Brazil (BACEN), announced that the pilot project of the Brazilian digital currency should begin in the second quarter of 2023 (BACEN, 2021). According to BACEN, Real Digital will lower the costs of banking operations and increase the inclusion of the Brazilian citizen in the new financial market characterized by Decentralized Finances (Defi), a model of decentralized finance operated on blockchain networks, which grows in importance with the adoption of value transactions through NFTs and Cryptocurrencies.

Cryptocurrency-based monetization/value exchanges utilizing blockchain technology offer greater security, transparency, and speed in transactions between users and companies offering digital products or services on Metaverse Experience Networks.

In addition, blockchain-based cryptocurrencies can facilitate integration between different platforms and ecosystems in the metaverse, allowing users to simply and efficiently transfer their digital assets between different virtual environments. This can increase the exposure and reputation of the brands that operate in this market, as well as expand the possibilities of partnerships and collaborations between them.

Therefore, cryptocurrency-based monetization/value exchanges that utilize blockchain technology can contribute to the increase of economic transactions in the metaverse, as they offer advantages such as security, transparency, speed, loyalty, engagement, integration and innovation in the digital landscape.

2.13) Analysis dimensions, elements and performance indicators proposed for the Dodecahedral Framework of Experience Networks

To summarize all the elements characterizing the twelve analysis variables proposed by the Dodecahedral Framework of the Metaverse Experience Networks, as well as qualitative questions, checklist of elements and quantitative performance indicators, Table 01 was developed presented below.

Table 01, in addition to presenting the twelve analysis variables proposed by the Dodecahedral Framework, along with their respective definitions, makes it possible to correlate each of these variables with complementary analytical elements, which provide the conduction of qualitative and/or quantitative analyzes of the emerging object of study Metaverse Experience Networks.

The basic research questions and the checklist of constituent elements allow subsidizing the conduction of future studies that aim to expand and deepen the qualitative questions related to the influence that the Metaverse Experience Networks will have on the conduct of business and marketing strategies in an immersive three-dimensional environment with a progressive level of realism. On the other hand, the performance criteria and indicators help to conduct quantitative studies that aim to measure the performance level of the Metaverse Experience Networks in each of the twelve analysis variables.

Table 01 – Analysis dimensions, elements and performance indicators proposed for the Dodecahedral Framework of Experience Networks

Analysis dimensions	Analysis variables	Definition	Basic qualitative research questions	Element checklist	Performance criteria	Quantitative performance indicator
Immersive Realism	**Three-dimensionality**	It allows creating environments and three-dimensional products that are close to physical reality and that can be explored by users from different angles and perspectives. This can lead to greater engagement, memorization and preference.	How does the three-dimensionality of Metaverse Experience Networks affect users' perception and sense of belonging?	Check if the immersive virtual environment has depth, height and width; whether objects and characters are rendered in 3D; whether there is perspective and movement in the scene.	Degree of depth and perspective that the virtual environment offers users, allowing them to move and explore different scenarios.	**Degree of Three Dimensionality (DTD) of a Metaverse Experience Network**. The indicator's formula is: DTD = (T1 + T2 + T3 + T4) / 4 T1, T2, T3 and T4 are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points in each statement . The statements are: T1 - I feel like I'm inside the immersive environment.] T2 - I can move freely through the immersive environment. T3 - I can explore different scenarios in the immersive environment. T4 - I can modify the immersive environment according to my preferences.
	Hyper-realism of environments.	It makes it possible to offer experiences that are potentially indistinguishable from physical reality, creating a sense of presence and immersion in users. This can increase trust, credibility and loyalty, favoring greater permanence in these environments.	What are the benefits and risks of creating and inhabiting virtual environments that are potentially indistinguishable from face-to-face reality?	Verify that the immersive virtual environment faithfully reproduces the sensory details of physical reality, such as colors, textures, sounds, odors, etc.; if there is coherence between the elements of the scene and the context.	Degree of fidelity and detail that the virtual scenarios present in relation to the physical world, generating a sense of presence and involvement of the users.	**Degree of Hyperrealism of Environments (DHR) of a Metaverse Experience Network.** The indicator's formula is: DHR = (R1 + R2 + R3 + R4) / 4 R1, R2, R3 and R4 are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points in each statement. The statements are: R1 - Immersive environments are as detailed as physical environments (detailing). R2 - Immersive environments faithfully reproduce the colors, textures, sounds and smells of physical environments (fidelity). R3 - Immersive environments allow a natural and intuitive interaction with the objects and people present in them (naturalness of interaction). R4 - The immersive environments are consistent and coherent with the laws of physics and logic (coherence).
	Immersive interactivity	It allows stimulating the intrinsic protagonism of users (active and collaborative behavior), who can actively interact with the content and with other users. In addition, the collective creation of experiences or digital assets (co-creation) can be encouraged, generating a sense of community and belonging.	How does the immersive interactivity of the Metaverse Experience Networks encourage users to become protagonists and collaborate with the content and collective experiences generated by them?	Check if the user can interact with the immersive virtual environment and with other users in a natural and intuitive way; if there are adequate feedbacks to the user's actions; whether it is possible to create and modify content collectively.	Degree of interaction and feedback that users can have with the virtual environment and with other users, through devices such as virtual reality glasses, motion controls, haptic gloves, among others.	**Degree of Immersive Interactivity (DII) of a Metaverse Experience Network.** The indicator's formula is: DII = (Presence + Action + Socialization + Immersion) / 4 Presence, Action, Socialization and Immersion are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points in each statement. The statements are: **Presence** - the degree to which users feel that they are present in the immersive environment, as if it were real. **Action** - the degree to which users can influence the immersive environment and the objects in it, through actions and interactions. **Socialization** - the degree to which users can communicate and collaborate with other users in the immersive environment, through voice, text, gestures, facial expressions, etc. **Immersion** - the degree to which users feel involved and absorbed by the immersive environment, without external distractions.

Analysis dimensions	Analysis variables	Definition	Basic qualitative research questions	Element checklist	Performance criteria	Quantitative performance indicator
Space-time rupture	**Synchronicity**	It makes it possible to communicate with users in real time (synchronous process), responding to their demands and expectations in an agile and personalized way. This can lead to greater satisfaction, loyalty and positive recommendation.	How does the synchronicity of real-time events and interactions in Metaverse Experience Networks influence users' sense of presence and community?	Check if the immersive virtual environment is updated in real time; whether there is instantaneous communication between users; if there is synchrony between visual and auditory stimuli; whether there are dynamic and unpredictable events that require user adaptation.	Degree of synchronization and coordination that users' actions have in the virtual environment, allowing them to carry out simultaneous and collaborative activities with other users in real time.	**Degree of Synchronicity (DSYN) of a Metaverse Experience Network.** The indicator's formula is: DSYN = (S1 + S2 + S3 + S4) / 4 S1, S2, S3 and S4 are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points in each statement. The statements are: S1 - The immersive virtual environment is updated in real time, without delays or interruptions. S2 - I can carry out simultaneous and collaborative activities with other users in real time, without difficulties or restrictions. S3 - I can instantly communicate with other users via voice, text or gestures. S4 - Visual and auditory stimuli are synchronized, creating a sense of realism and immersion.
	Not subject to the laws of physics	It allows transcending the limits of space and time of the physical world, offering experiences that would not be possible in face-to-face reality. You can create spatially unlimited environments, accelerate or rewind in perceived time, allow actions without physical consequences and fully customize offers to users. This can generate greater surprise, enchantment and differentiation.	How do spatial freedom, actions without physical consequences, and full customization of environments and experiences affect the behavior and ethics of users on Metaverse Experience Networks?	Check if the immersive virtual environment allows the user to perform actions that would be impossible or limited in physical reality, such as flying, teleporting, changing gravity, etc.; whether it is possible to broadly customize the virtual environment according to the user's preferences.	Degree of freedom and creativity that users have in the virtual environment, allowing them to perform impossible or improbable actions in the physical world, such as flying, teleporting, crossing walls, changing gravity, among others.	**Degree of Freedom and Creativity (DFC) of a Metaverse Experience Network.** The indicator's formula is: DFC = (L1 + L2 + L3 + L4) / 4 L1, L2, L3 and L4 are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points in each statement. The statements are: L1 - I feel free to explore and experiment with different possibilities in the immersive environment. L2 - I feel creative to create and modify objects, scenery and characters in the immersive environment. L3 - I feel able to perform impossible or improbable actions in the physical world, such as flying, teleporting, crossing walls, changing gravity, among others. L4 - I feel satisfied with the quality and diversity of experiences that the immersive environment offers.
Meta Culture	**Digital Identities**	It makes it possible to relate to users through hyper-realistic avatars, which represent their personalities, preferences and styles in the metaverse. You can create your own avatars or sponsor avatars of digital influencers, generating greater identification, affinity and admiration	How do hyper-realistic avatars represent and express the personal identities of users on Metaverse Experience Networks? What are the criteria and limits for creating and modifying avatars?	Check if the user can create and modify their avatar in a hyper-realistic way; if there are customization options for appearance, voice, gestures, clothing, etc.; whether there are mechanisms for verifying and protecting the user's digital identity.	Degree of personalization and expression that users can have when creating and controlling their avatars, which can be human, animal, or objects.	**Degree of Avatar Personalization and Expression (DAP) of a Metaverse Experience Network.** The indicator's formula is: DAP = (P1 + P2 + P3 + P4 + P5) / 5 P1, P2, P3, P4 and P5 are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points for each statement. The statements are: P1 = I can customize my avatar according to my preferences and needs. P2 = I can express my identity and personality through my avatar. P3 = I can choose between different types of avatars, such as humans, animals or objects. P4 = I can control my avatar easily and intuitively. P5 = I feel satisfied and comfortable with my avatar.

Analysis dimensions	Analysis variables	Definition	Basic qualitative research questions	Element checklist	Performance criteria	Quantitative performance indicator
Meta Culture	**Gamification and Advergames**	It allows incorporating playful elements into communication and immersive marketing strategies in the Metaverse Experience Networks, such as rules, route itineraries, individual challenges, collective competitions, rewards and rankings. Own games can be created or personalized ludic spaces can be inserted in existing games, generating greater fun, motivation and collective participation of users.	How can gamification and advergames be used to motivate, educate and persuade users in Metaverse Experience Networks? What are the advantages and disadvantages of these strategies?	Check if the immersive virtual environment has game elements, such as rules, objectives, challenges, rewards, etc.; whether there is integration between recreational content and educational or advertising content; whether there is user engagement and motivation to participate in the proposed recreational activities.	Degree of playfulness and fun that the virtual environment provides to users, through elements such as rules, objectives, challenges, rewards, narratives, etc.	**Degree of Gamification and Advergames (DGA) of a Metaverse Experience Network.** The indicator's formula is: DGA = (G1 + G2 + G3 + G4 + G5) / 5 G1, G2, G3, G4 and G5 are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points for each statement. The statements are: G1 - The immersive environment has clear and consistent rules. G2 - The immersive environment has challenging and motivating objectives. G3 - The immersive environment has varied and significant rewards. G4 - The immersive environment has an engaging and coherent narrative. G5 - The immersive environment is fun and stimulating.
	Privacy and interaction mediated by Artificial Intelligence	It makes it possible to protect the personal data of users of the metaverse Experience Networks, respecting their choices and consents. In addition, artificial intelligence can be used to mediate interactions between users and between them and brands/products, following ethical and transparent rules of conduct. This can generate greater security, trust and respect from users.	How can Artificial Intelligence guarantee the privacy and security of personal data and user interactions in the Metaverse? What are the rules of conduct that must be followed and respected by users in Metaverso?	Check whether the immersive virtual environment has Artificial Intelligence systems that help the user navigate, search for information, solve problems, etc.; if there is respect for the user's privacy and personal data; whether there are clear rules of conduct applicable to users.	Degree of protection and control that users have over their personal data and their activities in the virtual environment, as well as the degree of interaction and assistance they receive from artificial intelligence agents, such as chatbots and virtual assistants.	**Degree of Privacy ans Interaction Mediated by AI (DPI) of a Metaverse Experience Network.** The indicator's formula is: DPI = (PDP + PA + IIA + IU) / 4 PDP, PA, IIA and IU are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points in each statement. The statements are: PDP - average of users' answers about the privacy of personal data. PA - average of users' responses about activity privacy. IIA - average of user responses about interaction with AI agents. UI - average user responses about interacting with other users.
	Sustainability	It allows reducing production costs and the environmental impacts of activities carried out in the Metaverse Experience Networks, contributing to the sustainable development of the planet. Acting in these networks can considerably reduce the use of natural resources and polluting materials, reduce the emission of greenhouse gases and offset the carbon footprint.	How can the sustainability of Metaverse Experience Networks be ensured in terms of lower production cost, elimination of environmental impacts and reduced carbon footprint?	Check if the immersive virtual environment has a low cost of production and maintenance; whether it uses renewable or efficient energy sources; whether it reduces or eliminates the environmental impacts caused by human activity in face-to-face reality.	Degree of efficiency and responsibility that the virtual environment has in relation to the use of natural and energy resources, as well as the environmental and social impact that it generates in the physical world.	**Degree of Sustainability (DSUS) of a Metaverse Experience Network.** The indicator's formula is: DSUS = (FRN + EDUA + DUDC + REE) / 4 FRN, EDUA, DUDC and REE are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points in each statement. The statements are: FRN - The Experience Network uses renewable energy sources to maintain its operation. EDUA - The Experience Network promotes environmental awareness and education among its users. DUDC - The Experience Network respects the human rights and cultural diversity of its users. REE - The Experience Network minimizes the waste and emissions generated by its operation.

Analysis dimensions	Analysis variables	Definition	Basic qualitative research questions	Element checklist	Performance criteria	Quantitative performance indicator
Meta Culture	**Interoperability of Networks**	It makes it possible to transport digital identities, digital assets and virtual creations to any Experience Network participating in the Metaverse.	How can the interoperability of the member Experience Networks facilitate and enrich the mobility and diversity of users in the Metaverse? What are the requirements and standards for networks to be compatible and integrated?	Check if the immersive virtual environment allows the user to access and transit between different Experience Networks that make up the Metaverse; if there is compatibility between the formats and standards of these networks; whether it is possible to transport the user's digital identity, digital assets and creations to any participating network.	Degree of interoperability, compatibility and integration that the Metaverse Experience Networks have with each other, allowing users to access, transport and share identities, digital assets, creations, services and contents between the different networks.	**Degree of Interoperability (DINT) of a Metaverse Experience Network.** The indicator's formula is: DINT = (I1 + I2 + I3 + I4) / 4 I1, I2, I3 and I4 are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points in each statement . The statements are: I1 - I can easily access the Metaverse Experience Network from different platforms and devices. I2 - I manage to transport my identity, my digital assets, my creations, my services and my contents between the different Metaverse Experience Networks without losing quality or functionality. I3 - I can share my identity, my digital assets, my creations, my services and my contents with other users of the different Metaverse Experience Networks without restrictions or difficulties. I4 - I can enjoy the advantages and benefits of the different Metaverse Experience Networks without compromising my security or privacy.
Tokenized Economy	**Authentication of digital assets by NFT**	Enables the use of unique cryptographic authenticity codes that use Blockchain technology to guarantee the ownership and originality of digital assets in the Metaverse Experience Networks	How can personal and digital asset authentication performed by NFT ensure the ownership, originality and value of content and user creations on Metaverse Experience Networks?	Verify that the immersive virtual environment uses Non-fungible tokens (NFT) technology to generate unique encrypted codes that guarantee the authenticity and ownership of the digital identity, digital assets and user creations; whether there are security and transparency mechanisms for transactions involving these elements.	Degree of security and reliability that users have when acquiring or exchanging digital goods in the virtual environment using blockchain technology, which guarantees the authenticity and ownership of digital assets through non-fungible tokens (NFTs).	**Degree of Authentication by NFT (DANF) of a Metaverse Experience Network.** The indicator's formula is: DANF = (N1 + N2 + N3 + N4) / 4 N1, N2, N3 and N4 are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points in each statement. The statements are: N1 - I rely on blockchain technology to ensure the authenticity and ownership of my digital assets in the Metaverse. N2 - I feel safe when purchasing or exchanging digital goods in the Metaverse using NFTs. N3 - I believe that NFTs enhance my digital assets in the Metaverse. N4 - I am interested in acquiring or exchanging more digital goods in the Metaverse using NFTs.
	Blockchain-based value exchanges	Enables the use of payment and value transfer mechanisms that use decentralized and secure cryptocurrencies in the Metaverse Experience Networks.	How can cryptocurrency-based monetizations/value exchanges stimulate digital entrepreneurship, the creative economy and the productive participation of users in Metaverse Experience Networks?	Verify that the immersive virtual environment uses Blockchain technology to generate and manage cryptocurrencies that can be used as a means of payment or exchange of value between users; whether there are conversion mechanisms between the different existing cryptocurrencies; whether there is regulation and supervision of these operations.	Degree of transparency and decentralization that financial transactions have in the virtual environment using blockchain technology, which registers and validates operations carried out with cryptocurrencies.	**Degree of Blockchain Value Exchanges (DBVE) of a Metaverse Experience Network.** The indicator's formula is: GBLK = (B1 + B2 + B3 + B4) / 4 B1, B2, B3 and B4 are the averages of the users' answers for each statement respectively of the Likert scale, ranging from 1 to 5 points in each statement. The statements are: B1 = Degree of satisfaction with the transparency of financial transactions in the metaverse. B2 = Degree of confidence in the validation of financial transactions in the metaverse. B3 = Degree of ease of access and use of cryptocurrencies in the metaverse. B4 = Degree of preference for using cryptocurrencies in the metaverse over other forms of payment.

3) Conclusion/Contribution

The Dodecahedral Framework aims to characterize the new object of study Metaverse Experience Networks as a complex and multidimensional phenomenon, involving technical, aesthetic, behavioral, communicational, marketing and social aspects. In addition, this framework enables an integrated and systemic approach to Metaverse Experience Networks, which considers the interrelationships and mutual influences between the twelve analysis variables presented.

This framework also makes it possible to establish differentiations between the Metaverse Experience Networks and the Internet Social Networks, by highlighting the specificities and challenges of the former in relation to the others. For example, Metaverse Experience Networks require a greater degree of immersion, realism, interactivity, and user representation, as well as greater care for the privacy, sustainability, interoperability, synchronicity, authentication, and transactions of digital assets, which poses a considerably larger and more complex technical challenge of development and interconnection but, on the other hand, its potential in terms of virtual socialization, developments of innovative business models and wealth generation in an immersive virtual economy are also much broader.

The proposed framework presents potentialities for the marketing and relationship with consumers conducted by companies in the metaverse experience networks, by offering an analytical model that allows to identify the opportunities and challenges of each variable for the creation of communication, engagement, loyalty and monetization strategies in these immersive virtual environments. For example, companies can exploit the three-dimensionality of the environment to create sensory and emotional experiences for consumers; the high level of realism of immersive scenarios to simulate real or fictional situations; immersive interactivity to stimulate consumer participation and collaboration; the representation by avatars to personalize the products and services offered; gamification and advergames to generate fun and rewards; AI-mediated privacy and interaction to provide security and convenience; the sustainability of a virtual environment to demonstrate social and environmental responsibility; the interoperability of metaverse networks to extend consumer reach and integration; the synchronicity of actions to create a sense of presence and co-presence; the non-limitation to the laws of physics to enable innovative and creative experiences; the authentication of digital assets by NFT to ensure the exclusivity and originality of products and services; and blockchain-based transactions to facilitate commerce and payment on metaverse experience networks. In addition, the Framework presents a set of variables that can be used as criteria for the choice, planning, implementation and evaluation of communication, promotion and customer loyalty strategies in the Metaverse Experience Networks, considering the characteristics, preferences and expectations of the users of these immersive digital platforms.

The Dodecahedral Framework enables academic benefits for the advancement of research in relation to metaverse experience networks, by providing a theoretical framework that contributes to the definition, delimitation, classification and comparison of metaverse experience networks, as well as to the formulation of hypotheses, questions and research objectives. This framework also stimulates the development of interdisciplinary and multimethodological approaches that can capture the complexity and multidimensionality of metaverse experience networks, using different data sources, collection and analysis techniques, besides validity and reliability criteria. Also, this framework provides the emergence of new lines of research, topics of interest and research problems, which can expand scientific knowledge about the Metaverse Experience Networks of experience and its implications for society, culture, economics and law.

In addition, the Dodecahedral Framework brings academic benefits to the advancement of research in relation to the Metaverse Experience Networks, by proposing a theoretical model

that can be applied, tested, validated or refined in different contexts and empirical situations, contributing to the production of scientific knowledge about this new object of study, as well as to the identification of gaps, challenges and opportunities for future investigations.

In short, the Dodecahedral Framework of Experience Networks was proposed as a theoretical attempt to order the new and complex world made possible by the Metaverse, and may even serve as a checklist tool for academic and professional works, assisting in the mapping, characterization, analysis and subsequent taking of strategic actions related to the Metaverse Experience Networks.

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