MetaCity: The digital city as metaverse social enabler.

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Summary

With the pandemic forcing a prolonged lockdown, many people have had time to explore the Metaverse as an opportunity to understand the digital future. They have discovered something truly amazing to explore, participate in and share with others. These shared virtual spaces allow anyone to join a borderless economy with unlimited creativity. The Metaverse is a shared virtual space born from the convergence of physical and digital reality, and the Internet. Due to its human, social essence always associated with a possible world or virtual place, an obvious parallelism is established with the concept of city (place, human, social) which we call MetaCity, as a digital reflection of the concept of physical city. We will explore the different characteristics of this MetaCity, as well as its three main spheres of action (Leisure/Games, Social, and Business/Urban Services). We will discuss its advantages and challenges. We will explore the new city dual dimension and the possibilities that this entails for its constant effort to attract and retain talent, both to the real city and its virtual parallel. And we will end up dreaming of the possibilities of mental union of the inhabitants of a virtual city to co-create it and take it to its maximum splendor.

Keywords

Metaverse, MetaCity, Virtual Reality, Digital Twin, Phygital

Intro

In essence, a city is a place and a moment in time, it is therefore a point in space/time where humans develop their social facet, that is, they meet and encounter. In this way, we could say that the city is the social enabler par excellence. The city generates and proposes the conditions for humans to put their social abilities into practice. The city is, therefore, an enabler, a catalyst for social relations, for human development. The city creates the mechanisms for an exponential growth of individual human creativity. Man meets in the city to achieve synergies to dominate the environment, to improve their quality of life, to invent, to thrive artistic and scientific development. This is the physical city, the tangible city, the city that relies on brick-and-mortar urban planning. It is the city that is associated with certain climatic and geographical conditions, and at a time, at an age.

We live at the beginning of the fourth industrial revolution. This revolution is marked by innovation in information technologies associated with artificial intelligence and robotics. It builds on tremendous advances in computing power, data analytics, and artificial intelligence algorithms that simulate and even enhance human cognitive abilities. The technological innovations that harness the metaverse are leant on this development.

If we make an abstraction and mimetic parallelism between the physical and the virtual or digital, we can establish that the metaverse is a type of virtual city. Reviewing the previous definition of the essence of the city, we can find the following associations:

- Place turns from being physical to an imaginary place, a possible world. It is a possible world because basic relationships between people can be established in it. For (Gartner, 2022), the metaverse is an open and collaborative virtual space, created by the convergence of virtually enhanced digital and physical realities. It seems like the definition of the new term *phygital*, wanting to mix the physical world and its senses with the digital world, in a combined virtual experience.
- Time becomes diffuse. It does not have a clear association, although some metaverses position us in certain past or future times. Time is the dimension that marks the greatest distance between the physical and the virtual. In fact, you can lose sense of time after spending a few minutes immersed in the metaverse. Clearly, our brain and sensory organs are not prepared for these time uncertainties.
- The most important component is obviously the human one. Without humans there is no physical or virtual city. It would be questionable, as certain autonomous metaverses lack a permanent human presence, but the authorship of their creation

and the meaning of their existence, which are purely human designs, is unquestionable.

- And as the last component, but not least fundamental, we find the ability to socialize. An essential component in the physical city, the ability to foster social relationships is also essential in the metaverse. Even in those cases where just one individual user is exploring, or playing, or connected to virtual systems proposed in the metaverse, we could say that that person is interacting with the creators of those systems, and their experience and the actions they perform in that metaverse are analyzed and taken into account to improve the experience of other users.

For the new company Meta (former Facebook) and whose name change has fueled interest in this concept, Metaverse is "a set of virtual spaces that you can create and explore together with other people who are not in the same physical space." It is worth highlighting the social aspect of this definition, as it could not be otherwise, coming from a social network.

Therefore we can say that as soon as we can find the slightest social component, either explicit or implicit, that metaverse will ultimately be a MetaCity. It would therefore be a virtual reflection of the variety and richness of urban experiences that we can observe in the physical world, under the limitations and innovations provided by the latest technology in design, data analysis, animation, artificial intelligence algorithms, and information verification mechanisms and uniqueness (Blockchain).

We will study throughout the following pages the base elements that make up the metaverses or MetaCities. We will explore the three main metaverses groupings capabilities and functionality. We will analyze the impact on urban society in parallel to the development of real cities. Finally, we will study the benefits and advantages, and in contrast, the risks and questionable elements of this new dimension.

1. MetaCity. Base elements

1.1. Not that new. Theory of possible worlds.

Since the beginning of time, the human being has had a superpower: trying to materialize dreams and imagination. From the cave paintings through the painting and the artistic representation of hell by Bosch, to the literature of Jules Verne, and the surrealism of Dalí, to the seventh art with films like The Matrix or Blade Runner... all of them represent imagined worlds. Well, the availability of new computing technologies allows the creation of animated models that make possible the development and interaction with virtual worlds: the metaverse.

Possible worlds in literature have been well studied. The first to speak about possible worlds was (Leibniz, 1710) when explaining evil. This philosopher postulated that we live in the best possible world. The reason is very simple: we live in a world created by God, and therefore there cannot be a better one. He wrote in his Letter to des Bosses in 1711: "if it were not the best possible, God would not have created anything, as He cannot act without reason or prefer the less perfect to the more perfect."

This theory had its nemesis in the ideas of Schopenhauer. Schopenhauer concluded that we live in the worst possible world, fundamentally because that is how we men have built it, and it is the worst possible world because if it were only a little worse it would be destroyed. The concept of possible world remains undefined until modern philosophy, when Saul (Kripke, 1980) takes up the matter as an evolution of the Platonic concept of the world of ideas, postulating that possible worlds are stipulated by propositions and related descriptive elements. Contemporary to Kripke, David (Lewis, 1986) surprised the world with his affirmation that possible worlds are universes, and the real one in which we live is only one of the possible ones. We continue with literature as a powerful element for shaping our imagination, and in this sense, the Czech philosopher Lubomír (Doležel, 1998) founded the Theory of possible worlds or heterocosmic, based on the concept of mimesis, or parallelism between the real and fictional literature. In this way, the author defines three types of mimesis: real mimesis associated with a fictitious representation of something real; a universal mimesis where the object is a real archetype, may it be the hero or the villain; and finally a mimesis of possible worlds where the fictional entity has no referent in reality, but does not avoid having the same ontological level as the real world, for example a novel character, or any of the medieval fantasy worlds which

Tolkien enlightens us. Access to these possible worlds is done through semiotic channels, that is, from the text of the literary element where it is described.

If we consider the Internet as the massive and technologically advanced evolution of books, and graphic applications and animations as the evolution of literature and cinema, we conclude that a metaverse is just one possible world.

Later, Prof. (Albaladejo, 1999) provided semantics and a structure to the concept of possible worlds in literature, by considering the narrative text as a set of worlds with their elements, characters, properties and relationships, and each one with its semantic underworlds, such as the actual real, the desired, the feared, the hated, the feigned, etc. The multilinear narrative progression incorporates the appearances, eliminations, integrations and changes in these semantic underworlds that gives life to text. Reality, as the sum of everything imaginable, is therefore a universe made up of a great diversity of elements that are defined by the opposition of each of them to the rest of the components that define that world. (Ryan, 2006)

Therefore, we can well conclude that a metaverse is just a possible world developed with the artistic elements that new technologies in design and animation bring us. It is worth highlighting the extraordinary evolution in terms of interaction capacity. We start from a literary text that describes a world for whose representation we need to use our imagination. The current concept of web 2.0 presents us with two-dimensional possible worlds based on texts and images. The metaverse is supported by web3 and the aim is to achieve a level of interaction in three and four dimensions. That is, the metaverse is the materialization of thought and imagination using the latest state of the art technology (Snow Crash) (Stephenson, 1992). It is curious to discover the contradiction based on the fact that the technologies that help to dematerialize reality, generating virtual representations of the real world for various purposes, are the same ones that allow us to materialize the imagination and generate these possible worlds.

1.2. The fifth urban dimension

We are therefore witnessing the birth of a fifth urban dimension. To the three spatial dimensions we add the time dimension. As a fourth dimension, it allows us to accommodate urban services at the accelerated speed with which we live. Distances in the city are no longer measured in km, but in time. The city, as an enabler of social life, also allows human activity and development to take place in the shortest time possible. Time is the only physical dimension that we still do not control.

MetaCity emerges as a fifth dimension, as a new virtual reality plane that helps humans to achieve what they cannot achieve in the real world, observe what they cannot observe in the real world, and do what they cannot do in the real world. All under the very few and poorly regulated ethical standards and legal guarantees that we have on the Internet. Why now? Because we have already reached a point of exponential development of information and computing technologies that have provided us with the necessary performance and tools to be able to develop the concept of metaverse. The capacity for immersive experience provided by mixed or completely virtual augmented reality, the artificial intelligence algorithms that allow us to develop and simulate human behavior, the enormous advances in visual computing, modeling and animation, and the capacity to collect huge amounts of data in real time and being able to analyze them to learn and understand human behavior in different situations have made possible the beginning of the development of metaverse environments. The metaverse has already existed as an idea for about 20 years. It is now when new technologies make it feasible (Entrala, 2021).

1.3. Metaverses, Multiverses and other

The metaverse is therefore defined as a network of digital environments in which, thanks to advanced technologies such as virtual reality and the blockchain, allow the creation of simulated virtual spaces, which generate an immersive and, in some cases, multisensory experience, with many different uses.

Its disproportionate growth, the massive and compromised use of sensitive information such as digital identity, the use of cryptocurrencies and other virtual economic elements, and the extraordinary ability to simulate worlds and behaviors that do not match to reality, require the parallel development of corresponding regulation that allows this growth to be sustainable and secure.

As a foundation, this is a natural evolution of the Internet as we know it. It allows an extraordinary development of ecosystems for socialization, entertainment and collaboration. It enables the interconnection of 3D representation spaces that can be associated with the effective management of real environments or the generation of completely virtual worlds. It means the development of future user interfaces with all kinds of digital content. Therefore, the developments in the metaverse will generate the door or the gateway to all the new developments in the Internet. The door or gateway most adopted by users will enjoy recognition as the main key to future content on the Internet. Therefore, whoever develops these new interfaces, whoever holds that key, will

have extraordinary power in the future Internet. Users will have to develop and define their own avatars and digital identities to interact in this new world. In this way we will get used to a new dual normality where we will combine the physical experiences from the real world with the digital experiences from the virtual.

If we define the universe as the sum of everything that exists, all space-time and everything it contains, we could, based on the established parallelism, define the metaverse as the sum of all the digital existence of an individual or a community. Note the association of the metaverse with a user or a community, in short, with a person, with a social environment. Therefore, this imperative to have a human component makes the association between the metaverse and MetaCity stronger. As an added element we could define multiverse as a collection of multiple observable verses. Every verse in a multiverse shares common laws of physics, elementary particles, and everything else with the parent universe. These multiverses can share the same programming languages in the virtual world, be interoperable with each other, have some shared assets, and even avatars that can interact and exist in different metaverses.

The brief and accelerated history of the metaverse concept is sustained by several proposals and innovations that have been happening in parallel:

From the point of view of basic technology, the Internet was born in 1991 at the hands of Tim Berners-Lee, who invited the world community to intertwine content in the so-called World-wide web (www). In 2002 Michael Grieves introduces the concept of the digital twin as a virtual representation of any type of object, with its properties and relationships. The need to secure transactions and avoid spam caused the appearance of Blockchain technology by Satoshi Nakamoto (possible pseudonym of one or more people) in 2009. The 2010's and early 2020's represent an extraordinary revolution in the ability to computing, data analysis, modeling and simulation, all supported by the advancement of huge data processing centers (Cloud) and artificial intelligence.

From a conceptual point of view, and as an inspiration, we can say that the origin of the metaverse concept is based on the science fiction novel *Snow Crash*. In this novel, humans are shown as avatars in a virtual space. But the most influential novel and movie on the metaverse concept is, without a doubt, *Ready Player One* written by Ernest (Cline, 2011) and that was released by the hand of Steven Spielberg in 2018.

Fundamental in the development of the metaverse concept has been the appearance and evolution of cryptocurrencies. The first b-money appeared in 1998. Blockchain later allowed Bitcoin to be implemented in 2009. 2012 saw the appearance of the first NFT or

non-fungible tokens that we will explain later. In 2015 Ethereum and the first Smartcontracts were launched.

From the point of view of social metaverses, it is worth noting the appearance of Second Life in 2003, which still counts on an interesting user base. In 2015 Decentraland appeared as a fundamental basis for the metaverse development.

From the point of view of the metaverse as a platform for games and leisure, we can highlight as fundamental milestones the appearance of Roblox in 2006 as a game platform that allows users to create and play their own games. With great popularity, Pokémon Go appears in 2016 based on augmented reality. Subsequently, many games and interactive entertainment platforms showed up. It is worth noting today the largest transaction in the history of the technology companies' acquisition with the purchase by Microsoft of Activision/Blizzard for an equivalent of 69 billion dollars and which is interpreted as a determined commitment to incorporate gaming technologies to the business environments offered by this company.

But we should consider as the main two milestones that have made the concept of the metaverse more popular, the massive use of technologies in games, social networks and teleworking because of COVID pandemic lockdown, and the Facebook decision to change its name to Meta.

1.4. Characteristics

The metaverse means a new concept of virtual world supported by physical and digital realities and incorporates a series of very notable characteristics to study. (Global Digital Assets, 2021)

● A virtual world. This is, in my opinion, the most important metaverse feature. It can be explored using a computer, game console, mobile device, other wearable technology or other device, experiencing powerful 3D graphics and sound (this will get better with web3 and more 3D and multi-sensorial experiences). The aim for this is to make the user feel comfortable and more present in the metaverse, and presumably less present in the everyday world (where your body remains physically anchored).

● Interoperability: Digital assets and information in the metaverse can be exchanged across a variety of worlds, networks, and digital environments.

● Unlimited. Unrestricted Size: The metaverse is capable of hosting any size audience at any given time, without bandwidth restrictions and similar traditional limiting factors by utilizing the power and performance elasticity of large Cloud systems. This is technically achieved through a process known as sharding (load sharing between different systems), although it may evolve to more robust mechanisms as technology evolves over time. Therefore, there is no limit of users, experiences or worlds.

● Social. It provides an important use in socializing, meeting people, creating and strengthening relationships. The metaverse is fundamentally social. There are many other people there, represented as avatars. Some of these avatars can be bots, virtual agents, or impacts from an artificial intelligence. You can hang out with other people and do things together. It is more than likely that the social aspect is central to the Facebook metaverse given its history as a social network.

● Creative. People participate actively and permanently in its creation. Furthermore, metaverse content is likely to be created continuously and almost decentralized by a wide variety of sources, much like the Youtube model in today's context (e.g. Youtubers). Users interact with content, experiences and activities through their digital avatars, each with particular attributes and properties; also through special portable devices, and with their virtual contents based on NFT and available for purchase in markets such as OpenSea.

● Persistence. The metaverse is capable of displaying information, experiences, and content that are always available to users. There is constant availability: the vast number of worlds and digital assets that make up the metaverse are constantly available to all users: a user logging off does not equate to the digital world in that area being turned off, as it is in modern massively multiplayer video games, the digital world persists and is available every time users decide to log back in, in the same state where they left off or in an evolved state, since that metaverse can develop autonomously. This means that the virtual world is available whenever you want to visit. You can change it by adding new virtual buildings or other items and the changes will remain in place the next time you visit. You may be able to establish your virtual residence and possess (own) certain items with proprietary access and domain. The metaverse will be based on user-generated

content, digital creations, and personal stories from the user, much in the same way that social media is today. (Gaplines, 2021)

● Accessibility from multiple devices: In theory, the metaverse can be accessed through a huge variety of different devices and Internet providers, similar to how traditional websites like Facebook, YouTube and Google work. For virtual reality content, a suitable virtual reality headset is required. The idea here is to provoke as complete an immersion as possible in the virtual world. Although the metaverse is not reduced to virtual reality. There are and will be many other interfaces (Ranchal, 2022)

● Definite. It is made up of people who live and connect, and by clear and defined elements, with properties and relationships between them.

● Reactive. The environment reacts to user actions in real time. Metaverse fans and some researchers believe that communication may be more natural than a basic video conference because, for example, you can use your gaze to show who you are addressing (your avatar can turn its head to look at that person). Your avatar could also walk around and sit next to another person's avatar to start a conversation, encouraging interactivity.

● Transactability: Like in the real and tangible world, the metaverse includes a functional economy that allows users to buy and sell a wide variety of goods and services, all of them virtual, such as tickets for events, vehicles, real estate-type properties, and NFTs items, plus special physical devices for interaction and more. The transactional nature of the metaverse is expanding rapidly with the increase in providers of goods and services entering virtual space.

● Interoperable. Cross-platform: The metaverse consists of a complex network of platforms, applications, and digital worlds. It should not be tied to specific platforms owned by any provider or manufacturer. Possessions and identities should be able to move freely. At the moment, many of these questions depend on the metaverse you are in.

● Everyday linked. There must be some connection to our daily activities / connection to the real world. In some visions of the metaverse, virtual things in the virtual world

represent real things in the real world, being their exact representation. For example, you can fly a virtual drone in the metaverse to steer a real drone in the real world or do simulation exercises in the metaverse with real physical situations. In this case, it is said that the metaverse builds "digital twins".

● Decentralized. Multi-Governance: There are multiple implementations within the metaverse that vary from those that are centrally managed by a manufacturer/vendor, to those that are governed in a fully decentralized manner through democratic processes and semi-autonomous mechanisms, as in the case of decentralized autonomous organizations (DAO). DAO's are community-owned, (for example, a society of metazens that evolves autonomously with certain rules is programmed and its evolution is evaluated to study human social behaviors), or may include other metaverses where each user is a partner, co-owner and can do / build what they want – with basic rules of coexistence and growth, construction and destruction. The entirety of the metaverse is not owned or managed by any group or entity, nor is the entirety of the Internet.
Even with this feature, there is a clear intention on the part of big manufacturers like Facebook (now Meta) to dominate it (Risberg, 2021)

1.5. New challenges and concepts to regulate

There is a series of new concepts and virtual elements and new disruptive technologies that propose new forms of human relationship, ownership of intangible assets, and identity management and digital rights that await the corresponding regulation to prevent abuse, fraud and manipulation.
As ever, technology evolves at an accelerated rate far ahead of the necessary regulation. Therefore, this type of digital asset implies an additional risk since it does not have a solid legal or contractual validity. In addition, users expose, to a greater or lesser extent, their digital identity, with the consequent risk. We are going to comment below on some of these new elements and technologies.
NFT (Non-fungible tokens). NFTs apply to simple, unique, non-divisible digital assets, often associated with works of art or digital icons, and which use blockchain to record and verify ownership, and validate their authenticity. (Shepherd, 2021). These are still unregulated items, and it is surprising that they have attracted a huge amount of business ($27bn in 2021) (SmartCityJournal, 2022). They allow granting something like a property certificate, a smart contract, with the uniqueness and guarantees provided by blockchain

technology for any type of digital asset. It would be like a notarial certificate of virtual property. It also applies to contracts and digital properties in the metaverse such as farms, buildings and all kinds of digital elements.

Digital identity. In addition to the elements that make up our basic digital identity, that is, information about us, our national identification numbers and passport, housing, properties, vehicles or even the preferences that we have shown with our clicks on Facebook, we must now design our avatar for the metaverse. This avatar will be our digital representation and can be as true to our reality as we want. There is no mechanism to verify that said avatar even looks like us (there is no policeman to verify that it is a faithful representation of our face and body). Therefore, we can make an avatar where our friends and acquaintances recognize us (there are excellent technologies for generating avatars that are almost perfect for our physiognomy) or we can choose to generate fictitious avatars that have nothing to do with our real image, and that obviously can induce to hide our identity, pretend to be a completely different person, seek anonymity or try to deceive. Each one of us digital identity ownership is the solution to this legal challenge. In this sense, the European Commission recognizes our digital rights and promotes the development of new decentralized virtual identity technologies (eIDAS) where the citizen is the sole and exclusive owner of their identity, being able to share part of it to different institutions and companies in exchange of certain public or private services. (EU, 2021)

Intellectual property. In this new concept where multiple entries and contributions from numerous users are brought together, the principles of co-authorship and co-ownership are, without a doubt, the most important legal challenges.

Data protection and privacy. The more data we share, the greater the risk that it will be misused, and the more difficult it is to protect against fraudulent access and use. The absence of a regulatory entity on the Internet and in the metaverse, by extension, poses a legal challenge since it is not easy to determine who is the authority responsible for guaranteeing the protection of our data and their privacy.

Competition law. The existence of monopolies must be prevented and the exchange of confidential information without the knowledge and permission of its legitimate owners must be avoided. The generation of monopolies in the metaverse would pose an obvious risk to life and social activities in the real world. In this sense, it is necessary to promulgate new laws, procedures, training programs and control mechanisms that verify free and universal access to the metaverse, to know who owns the virtual space through which I

am interacting and what is going to be done with the information that I share or that I generate with my activities in it.

DAOs (Decentralized Autonomous Organizations). This new type of organizations govern some decentralized metaverses, not linked to any country, where there is no traditional organization or hierarchical governance structure. Therefore, they are not under the control of any human authority, so the risk of fraud and improper use of information and intellectual property is beyond any control. The users are mostly human, but can also be automatons. Anyway, the creators of the rules under which those metaverses function and evolve automatically, are human. Therefore, there is always direct or design authorship. The problem is the lack of control over their operations and the possible consequences. (Reiff, 2021)

2. The three spheres (Games, Social and Enterprise/Industrial)

The three spheres and their relationships.

We can recognize among the various metaverse proposals three clearly differentiated groups: those simply intended for video games; those who try to fully develop the social and consumer human being facet; and finally those that have a business purpose and that facilitate the business or operations of a company or institution.

These three spheres are not disjoint and overlap each other. In this way, we see the use of gamification in business applications, the contribution of psychology to improve and make virtual business meetings more cordial, and open creativity in the permanent development of improvements and alternatives in all of them. Let's address them in more detail.

2.1 The MetaCity of games. Gaming metaverse.

The metaverse promises to help us escape the world we live in, to play in a more visually pleasing, imagined, virtual world. Also, if you die in the game, you will simply respawn with a new life and start all over again. It is a world free from negative or fatal consequences. Everything is leisure, playful.

Video games are undoubtedly the utility that the metaverse has developed the most to this day. There are many platforms in video games, but it is worth highlighting the three most important:

Roblox. It is an open gaming platform where players can modify their world while interacting and playing with others. It is the first major company in the metaverse to go public. The Roblox developer community generated more than $530 million in 2021. Roblox sells virtual currency that players can use to purchase digital items that they incorporate into their games. It is even creating a new virtual world together with Nike (Niketown) (Spencer, 2022)

Fortnite. What initially consisted of a cooperative game between four players to defend a base (Battle Royale) has become a huge global success. It's one of the biggest cultural phenomena in the metaverse, as evidenced by the massive virtual experience of over 10 million DJ Marshmello virtual concert attendees. (Parks, 2020). It also incorporates V-Bucks, its own virtual currency.

Minecraft. It is a small block-based building and game development platform. It's like an animated virtual Lego. It is widely used in educational environments to build new spaces

and make proposals to the city about how citizens would like certain spaces to be transformed. (Ali, 2022) There are other tools that also contribute to the co-creation of new spaces and a new urbanism designed from the metaverse. (Martinez, 2022)

We could also think of the concept of MetaCity as a huge amusement park built in the metaverse. There are already initiatives in this regard and even Disney itself is studying incorporating the metaverse technology available within its physical parks. (River, 2022)

It is a mistake to think that these are young people fascinated by video games: the average player in the USA is 34 years old, owns a house and has children, 45% are women. (Statista, 2022)

2.2 Social MetaCity Social. Consumer metaverse

The social aspect is, as we have seen, inherent in the metaverse. Clearly, social networks are evolving towards this new digital concept. The pandemic has only accelerated the adoption trend in new technologies for social relations. We see how numerous proposals have come to market and how general interest has accelerated with the announcement of Facebook (including its branding changed to Meta) as a complete transformation of this social network into a metaverse. In parallel, the main commercial brands are also already investing in this new field to fundamentally attract the potential of Generation Z consumers. (Donnelly and Innes, 2022) This group will reach 30% of potential consumers by 2030. Thus, we see how very famous textile companies such as Balenciaga, Ralph Lauren and Gucci offer exclusive virtual products. Likewise, the Walmart company offers a varied set of virtual retail products. Also, companies in the real estate sector have launched to offer properties such as parcels, buildings and homes in virtual space. (Cisman, 2022). The current opportunity is already around one billion USD (Aparicio, 2022)

The ambition of popularity and notoriety is thus transferred to the metaverse. It is there where we are going to develop an intense social life and show our friends our virtual possessions such as home, car, clothing, devices, etc.

The user experience is increasingly powerful and beneficial for this social relationship. It is incorporated into the voice as an element of direct communication and interaction with the system to build our own metaverse. (CincoDías, 2022)

2.3 Enterprise / Industrial MetaCity. Teamworking. Digital Twin

We proceed to discover the sphere of the metaverse that is most useful for human development: the Enterprise/Industrial sphere.

The metaverse represents a revolution in the new hybrid way of working, making traditional video calls more attractive, suggestive and can be complemented with artificial intelligence elements that make them more efficient.

The workplace evolves to incorporate a dual approach: a complete virtual world connected with collaboration and communication tools is added to the usual physical environment in the office. In this way, virtual meetings can be organized in different subworlds and digital assets are added that offer a more realistic experience. This immersive mode allows the inclusion of user holograms (holoportation) or from an object or concept that is going to be discussed. 3D avatars, multiple devices, gestures synchronized with speech (audio cues) or the complete generation of new virtual spaces associated with the company are also incorporated. Additionally, analytical artificial intelligence tools, natural language recognition, chatbots are incorporated and the user experience is analyzed to make it as realistic and immersive as possible. (UC Today, 2021)

Education and research environments, including healthcare, are also being revolutionized by this new paradigm. In this way, educational environments take full advantage of virtual reality capabilities to explain new concepts to students as realistically as possible. They take advantage of assistant and virtual teacher technologies to have access to all the necessary content at any time and from any device. The virtual classroom experience is very similar to the real one with the highest degrees of socialization. (Metaverse School, 2020)

From the research point of view, advanced visualization, virtual reality and graphic interaction have progressed in an exceptional way. Computer animation systems, simulation of large groups of people, geometric and procedural modeling, and the ability to generate large models allow the study of human behavior and the semantics of cities using tribes of metazens. (Patow, Pelechano & Rogla, 2021)

It is worth noting the strong metaverse connection with the monitoring and management of the physical world through the IoT (Internet of things, sensors, actuators, etc.), robotics and the generation of digital twins.

The concept of the roboverse arises as a bridge between the physical and the digital environment but in the opposite direction to the metaverse. If the metaverse projects us from reality to the digital world, the roboverse controls from the cloud the robots that help

us in the physical world. The roboverse makes us live better in the real world. Those robots are deployed around the world to perform more and more complex tasks exponentially. They are managed by software systems from the Cloud, which orchestrates their coordinated work. (Pestoni, 2022)

It is worth mentioning the new *phygital* combined experiences where we design systems for tourism promotion environments that combine a place, a physical environment and an associated digital experience. For example, we can go to the Belfast shipyards where Titanic was built, and through an immersive experience in augmented reality, virtually visualize the great boat that set sail from there. (Yellow Design, 2022)

The concept of the digital twin deserves special attention. It is a virtual 3D representation of the physical world. This technology began in the industrial environment associated with a specific device, a machine or a system to be remotely monitored and managed. As an extension, we can associate it with each and every one of the physical elements that make up a city. Each of them is incorporated as an identity defined by a metadata standard, properties and relationships with the others. Through these relationships we can develop applications and artificial intelligence algorithms that allow us to learn from existing data and generate predictive behavioral models. The digital twin is therefore a subset of the metaverse that needs real data from IoT sensors. It allows real-time monitoring and can help us develop simulations. We can say that a digital twin is a metaverse exactly true to reality. Therefore, a digital twin gives us enormous advantages in three specific areas:

1.- On the one hand, it allows us to integrate data of a very different nature such as traffic, time, infrastructure and other resources to innovate in areas such as Urban Mobility, emergency management and energy use. This way we can experiment with the details of the physical city without having to modify or touch it.

2.- The second area is innovation. We can test the benefits that new structural elements, engineering, urban planning and other infrastructure possibilities would bring us. This offers us the opportunity to accelerate and multiply inspiration, ingenuity and tenacity in our management of the city.

3.- Finally, and as the most important area, simulation is worth highlighting. We can test the different alternatives to solve a problem, eliminating the need for physical experimentation, saving costs associated with the use of physical elements and works, and avoiding inconvenience to neighbors. These simulation techniques allow us to make the best decisions without the cost associated with tests, with the guarantee that the city's predictive model tells us which will be the most appropriate. (Deblaere, Eitel-Porter,

Krüger, & Purdy, 2002) For example, we have a pollution problem in a square. We have different alternatives, such as the closure of some adjacent streets, the pedestrianization of others, or the diversion of vehicles through some alternatives. We can try all of them, and finally determine the optimal one, without having to cause any disruption to the normal life of the city. Additionally, we can evaluate the consequences of each one of them in the other parameters of the city, such as traffic, noise, etc. (Many are the cities that are using these advanced technologies to face their main challenges, such as Helsinki in energy, Gothenburg in resilience and urban planning, Porto in water management, Antwerp in joint management of traffic and pollution, and many others. (Bentley, 2020)
The ideal would be a complete hologram representation of the entire city, with the mayor and his leadership team managing that model, understanding the main issues in real time and evaluating the possibilities to make the most optimal decision. Unfortunately, the current state of artificial intelligence only allows to program algorithms to solve one type of problem, such as traffic, pollution, noise at the same time, not all together, but it is a matter of time before this becomes universal and all integrated. Additionally, there are already pilot models regarding the generation of social digital twins that try to understand human behavior in the city, in real time, and adapt their physical urban parameters to those behaviors. For example, if citizens do not wait at a traffic light, why do we turn it red and stop traffic? Or, on the contrary, if there are many citizens waiting, should we reduce the time we grant cars?
Much has been said about how technology enables city remote semi-automatic management. Several movies have dedicated a lot of time on this concept. (BradShaw, 2014). Also, the developments of futuristic cities such as EPCOT in Disney (Vinuesa, 2022) were based on this remote intelligent management. Even countries: Estonia is the main reference of the use of Cloud for the complete virtual management of a country, allowing total resilience against foreign invasions and maintaining control of State organizations at all times. (Estonia, 2022)

3. Implications for Attractive Cities

3.1 Talent in the physical City vs Metacity

What makes a city attractive to retain and attract talent has been studied in depth (Ondiviela, 2021). There is a global competition between all the cities of the world to attract more talented citizens. Talent implies prosperity. In this competition, cities improve their external image and their living conditions. They also improve the quality of services they offer to citizens, while trying to reduce their tax burdens. We can assimilate the decision to move to a city with an engagement, a marriage, a decision to purchase or invest in the medium/long term. Like any human decision, it includes an emotional component. We need to like the city with its identity-past, its dynamism-present and its strategy-future. In addition, it has to mean a good decision from a rational point of view. We must evaluate the proposal (citizenship contract) that is, the balance between the services and benefits that the city is offering us versus the cost that living in that city entails for us compared to others.

Therefore, the city wants us to live there, to develop our economic activity and pay taxes in that city. The Metacity proposes an alternative: what if I carry out my wealth-generation activity fundamentally in a Metacity that is economically associated with a city other than the one I live in? The paradox would arise that the city where I physically reside provides me with physical services but does not receive my economic contributions related to my activity, since I develop them in a parallel metacity not associated with that city. This is totally unfair, since the physical city gives me the physical services I need to live the way I want, and therefore it should also receive my contributions to the development of the city and pay for those services. In the other way, the Metacity where I do my activity (work, generate wealth, etc) may pay taxes elsewhere, which honestly does not make any physical effort for me or provide me with any physical service. One takes the profits and the other supports my physical needs... For all this, the cities will also try to attract Metacities, both the generic global ones and the investors that they entail, as well as develop their own ones as a faithful reflection of themselves.

3.2 Opportunity for those not-very-attractive Cities.

We observed how many cities that are unattractive due to various circumstances: climate, long distances and other conditions that are almost impossible to modify, invest heavily in SmartCity technologies to compensate for this lack of natural attractiveness. (See

Figure 1). The metacity is a fantastic alternative to achieve the same purpose. If our city has horrible weather or is very far from the main population centers, we could develop a MetaCity as a digital twin of our physical city and make it very attractive for talented citizens, their activities and businesses. Seoul, Doha and Singapore are already working on it. (Smart Cities World, 2022)

Figure 1. Comparison of Top175 most Attractive Cities (Horizontal Axis, left as best) vs SmartCity vs Attractiveness difference (Vertical Axis, Up as more Attractive than Smart, Down means Smarter than Attractive). From WW Observatory for Attractive Cities 2021 Report (Ondiviela, 2021).

Those into the red oval invest heavily on Smart technologies to gain positions and compensate their lack of attractiveness (due to multiple reasons) and are main candidates to invest on a parallel MetaCity to attract talented citizens virtual activity. Those over the horizontal axis don't feel that urgent need, but the obligation to provide better advanced services through innovation investment will push them as well.

4. Benefits and Challenges

4.1 MetaCities benefits

There are many benefits from metaverses and Metacities, such as their adaptation to the urban environment. Let's list some of them:

Clearly the metaverse extends human knowledge.

It helps us to improve and expand consciousness and the human sense allowing us to recognize the value of human creation.

It makes us freer in the sense of being more independent from the physical environment and its conditioning.

It eliminates age barriers allowing anyone to have the same possibilities and access in the metaverse.

Develop new business models in the virtual space as we have already described.

It represents a very remarkable acceleration and growth in human creativity.

It makes everyone equal and eliminates the physical barriers faced by the disabled. Note that in the movie *Avatar*, the protagonist was a physically disabled person.

It enables a revolution in remote education and in advanced education centers.

Avoid any type of physical limitation.

Artificial intelligence improves the automation of machines and physical elements, achieving a semi-automatically managed city.

It manages to reduce the design and production of all kinds of products.

It has a very positive effect on the environment. Anything that involves reducing the volume of travel (mobility and transport) and the consumption of physical matter means an improvement in the objectives of reducing emissions (Carbon Neutral) and efficient management of matter on our planet. (Circular City)

In the retail sector, it allows you to offer an excellent personalized experience without having to go to the store. (try alternatives, compare, etc)

It allows testing of all kinds of products before making a physical launch.

Virtual spaces also represent an opportunity from the point of view of marketing and advertising.

Its evolution in the roboverse will allow robots to help us with the most complex and painful tasks.

It represents a revolution in tourism by offering a combined physical and digital experience to visitors to a unique area or place.

Digital Twin applications allow managing and solving the main problems of the city by testing the different alternatives without having to modify the physical space or bother the neighbors, with very significant savings in costs and in citizen satisfaction.
It allows personalization and adaptation of virtual services to the needs and behavior of citizens, making them much more efficient.

4.2 Challenges, associated risks and reasonable objections.

But there are also many associated risks, potential problems and threats. Let's study some of them:
Unwanted contacts may be caused. In this sense, there is a risk of abuse of the most mentally vulnerable.
There is a notable risk associated with cryptocurrencies.
Addiction. Loss of real awareness of reality. (Jimsta, 2020) In this sense, Zuckerberg himself encourages his employees to disconnect at least every 30 minutes, become aware of physical reality again and refresh their minds. (Brown, 2021)
Loss of the physical social dimension of physical contact.
For the youngest, risk of bullying, harassment and inappropriate content. Minors are unable to regulate the level of the experiences they seek to achieve. Also in minors, the cerebral prefrontal cortex, which is the area associated with emotion and behavior regulation, is not fully developed yet, with the risk of doing it incorrectly. (Strange, 2021)
Lack of legal regulation, as we have already studied.
Lack of development of ethical regulations that govern the human-robot-avatar relationship.
Loss/theft of digital identity: *phishing*.
Risk associated with the minimal use of our body and our muscular system. It is not a physical leisure. There is no care for our body. Risk of muscle atrophy. If the muscles are not used, they will be lost.
The educational system is not adapted for the use of these new technologies.
Risk of rapid speculation around virtual assets.
Risk of sexual harassment. Much has been debated as to why most avatars lack legs and only have a trunk and abdomen. The main reason given was the lack of computational capacity for a part of our body that is not very expressive or significant in social relationships, such as the legs. Another interpretation aims to avoid the existence of sexual organs with the corresponding risk of misuse. (Metz, 2022)

Negative impact on the environment. The powerful computing systems required for massive utilization of the metaverse also require enormous amounts of power to operate. The metaverse in general is still under construction. There is too much expectation, and it can lead to disappointment.

Conclusion

While the metaverse is still in its early stages, the continued development of innovations, user adoption, utilization in large corporations, technological advancement and integrations, as well as rising valuations of associated digital assets, are indicative of the continued growth of the metaverse and the likely trajectory toward its destiny as the next third-generation, immersive, three-dimensional Internet.

This enormous opportunity for human development has its advantages and disadvantages, but it seems to be consolidating itself as an innovation for the future that we all will live with. The parallelism between the metaverse and the possible literary worlds suggests that the first is assimilated to a virtual city: the MetaCity. This concept represents a revolution in the way of operating and offering public services in the city, in the social relations of its citizens and in their leisure activities. Our city, therefore, incorporates a fifth virtual dimension. It is also a new challenge, a new opportunity to improve the attractiveness of our cities in their global competition to attract talent (in this case from its virtual dimension). Like all human developments, the ability to generate new business models and new services for citizens will be the determinants of the speed with which the metaverse is consolidated in our lives. Much remains to be done, as it is still in its infancy and there are many alternatives and a range of possibilities to explore. Some will be discarded as impossible or ruinous, others will finally consolidate the advantages and benefits of this new concept for the good of humanity. If we observe the parallel development of neurotechnology and remember once again the movie *Avatar* where the protagonist connected his hair with the *mother tree* uniting in a single community consciousness, could we dream as the American urban planner Jane (Jacobs, 1961) did about a beehive city, where we are all co-creators of it and we can all enjoy its benefits by connecting our minds to the MetaCity? We still have time to reflect on this.

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