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METaverse CITY: DEFINITION AND DIRECTION DEVELOPMENT FOR URBAN PLANNING AND ARCHITECTURE

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Abstract

Technology corporations believe that the Internet in its current form will become irrelevant in the foreseeable future. In its place, the metaverse will come – a global virtual space in which it will be possible to live, work, meet friends and do all other daily activities. Many consider this direction as a continuation of the sustainable development and smart city concept. The article considered the latest data on the metaverse direction, tries to analyze this trend and its relationship with architecture, sustainable development and urban planning with the help of scientific literature, their analysis and the actual stage of this trend.

This analysis led to the conclusion that each city has its own system of consistent urban thinking, and solutions to achieve the goal of sustainable development, including the metaverse direction. In conclusion, based on the entire analysis, the author formulated the relationship of metaverse with the concept of sustainable development, the advantages, risks and disadvantages of metaverse for the city and citizens.

Keywords: metaverse, urban development, virtual world, virtual city, urban transition, augmented reality (AR), virtual reality (VR).

ГОРОД МЕТАВСЕЛЕННОЙ: ОПРЕДЕЛЕНИЕ И НАПРАВЛЕНИЕ РАЗВИТИЯ ДЛЯ ГРАДОСТРОИТЕЛЬСТВА И АРХИТЕКТУРЫ

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Реферат

Технологические корпорации считают, что Интернет в его нынешнем виде станет неактуальным уже в обозримом будущем. На его место придет метавселенная – глобальное виртуальное пространство, в котором можно будет жить, работать, встречаться с друзьями и заниматься всеми прочими повседневными делами. Многие считают данное направление как продолжение концепции устойчивого развития и умного города. В статье рассматриваются последние данные о направлении метавселенной, делается попытка проанализировать данное направление и его связь с архитектурой, устойчивым развитием и градостроительством с помощью научной литературы, их анализа и актуального этапа данного направления.

Данный анализ позволил прийти к выводу, что каждый город имеет собственную систему последовательного урбанистического мышления и решений для достижения цели устойчивого развития, в том числе в направлении метавселенной. В заключении, на основании всего анализа, автором сформулированы связь метавселенной с концепцией устойчивого развития, преимущества, риски и недостатки метавселенной для города и горожан.

Ключевые слова: метавселенная, городское развитие, виртуальный мир, виртуальный город, городской переход, дополненная реальность (AR), виртуальная реальность (VR).

Introduction

With the spread of the Internet, people began to perform some of the activities online. Today we play sports on YouTube videos, for learning languages there are online resources that replace language schools, instead of libraries and cinemas, we can use streaming services and applications with books and audiobooks. To make purchases, it is not necessary to leave the house, even the products will be kindly delivered by a cybermarket or a scooter. We use applications to interact with government agencies and can file a tax return online instead of going to the tax office.

By 2026, a quarter of people will spend at least an hour a day in the metaverse, according to a study by Gartner. According to experts, users will visit virtual offices, classrooms and shops, build houses in the digital space and even buy land [1]. Most of the research comes to the conclusion that more than half of the live events by 2030 will take place in the Metaverses – for example, educational and developing. The average Internet user will spend up to 6 hours a day in the digital worlds. According to experts, e-commerce will bring the greatest income in the Metaverses: their development will affect 80% of commerce, and as of August 2022, this is almost 4.7 trillion dollars. A fair question may arise here: for whom is the Metaverse more beneficial? Of course, first of all, for corporations, brands and companies promoting their services. But it is worth noting that everything happened similarly with the Internet. For companies, this is a platform for earning money and advertising, and for the user, it is an opportunity to receive content, create it and share impressions.

The Metaverse should provide the same variety of possibilities as the Internet. New companies, products, and services will emerge to handle everything from payment processing to identity verification, hiring, advertising, content creation, security, and so on. As consumer attention shifts more and more to virtual goods, services and experiences. It will also change where we live, our infrastructure, and how different tasks are distributed, both in the physical world and within the Metaverse.

Research methodology

Research methodology would be used literature review; pattern recognition; identification and conceptualization methods for contribute the results of study. For this occasion, main stages and methodology of this research are like as follows:

1. Literature review and analysis method: latest scientific literature, interdisciplinary text and documents with a suitable thematic analysis related to metaverse, sustainability, urban development and architecture.
2. Pattern recognition is the ability to see patterns in seemingly random information. The goal is to note the main patterns and concepts in the results of the first step. The second step looks for similarities or patterns in the sample and codes the results by concept.
3. Identification method: to recognize specific, problems and characteristic of metaverse and its relation to sustainability and urban development (results of part one and two).
4. Conceptualization method: in order to find a suitable theoretical connection between the identified concept and its relation to metaverse, urban development, sustainability, architect and architecture.

Main part

The pandemic situation in 2020 has shown us how it can be really boring to work from home and not go out and it's around the clock. Thus, working and living in the metaverse in this situation definitely helps people to have fun in another world; work, study and do their daily real life there at the same time. Many experts believe that the metaverse will soon become a replacement for social networks, but so far this is just an emerging trend.

1 Basic information about Metaverse**1.1 What is the Metaverse?**

The first idea of the metaverse appeared in 1992 in the science fiction novel *Avalanche* by Neil Stevenson. According to the plot of the book, in the 21st century, corporatocracy reigns on Earth – all power belongs to the large corporations – and in addition to the real world, which is shrouded in chaos and split into several corporation states, there is another one – a virtual one. There, people interact with each other in the same way. The real and virtual worlds are intertwined: events in one can affect what happens in the other. The same book became the origin of the term “avatar”.

The Metaverse is a convergence of physical, augmented (AR) and virtual reality (VR) in a common online space. The prototype of the Matrix in the real world is the Internet. The difference between augmented reality and virtual reality (VR) is that augmented reality only adds individual elements to an already existing world. Virtual reality artificially recreates the whole world. Having created his avatar in the metaverse, a person will be able to do almost everything in VR that he does in the real world, for example, search for information, communicate with friends, work, go for a walk. In short, to live in the new universe the way he wants and own anything (Figure 1) [2].

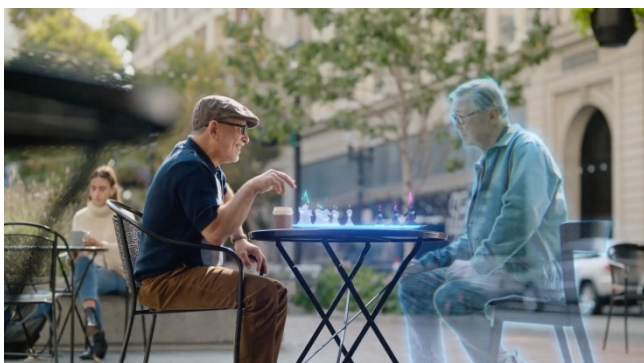


Figure 1 – Convergence of physical and virtual reality concept

Some people may think that the metaverse equal video games, but the two should not be equated. There are many metaverse concepts, but the most famous one belongs to venture capitalist Matthew Ball. In his presentation, Ball gives seven characteristics of the other world:

1. The Metaverse will not stop: it cannot be restarted, paused, erased or terminated. It's the same as real life.
2. All events within the universe occur in real time, and actions do not depend on external factors. Even though the Meta will have pre-planned events, just like real life, it will be a living, holistic experience for one and all in real time.
3. There is no limit to the number of those who inhabit the metaverse.
4. The metaverse has its own economy: people receive “money” for the “work” done, own and manage property. Individuals and businesses will be able to create, own, invest, sell and be rewarded for an incredibly wide range of “work” that generates recognized “value”.
5. In the metaverse, you can use elements of the real world: for example, work on your laptop in a virtual space.
6. Data and digital assets from different platforms are combined. There must be absolute compatibility of different “worlds” in the Meta, their data, digital assets and the content that they contain. You can use things from Counter-Strike and Fortnite, buy a car from Need for Speed and sell it to friends on Facebook. As if your Counter-Strike weapon skin could be used in Fortnite or any other game. Today, the digital world is like a shopping mall, where each store uses its own currency, different IDs, own units of measurement, etc.

7. The Metaverse is filled with “content and experiences” created by its users, both individuals and organizations.

The concepts described above form the image of the target state of the Metaverse and the understanding of how it should function. At the moment, there is not a single Metaverse that meets the above criteria. There are many projects that have implemented individual elements of the Metaverse, while the creation of a full-fledged Meta is a matter of more than one year.

1.2 Historical background

Despite starting the metaverse idea in 1992, the concept of the metaverse gained attention after Facebook changed its name to Meta in 2021 and announced a major investment in the idea. Then the creation of their metaverses was announced by Microsoft, Epic Games, Roblox and other corporations [3]. But even before this event, the idea of a virtual world and augmented reality was of interest to people, and the concepts of virtual worlds were not invented by IT giants at all, but by science fiction writers.

Also in history, the following key events affecting the Metaverse theme can be distinguished:

1978 – The MUD (Multiple User Dungeon) game is a computer program that users can enter and explore. Each user takes control of a computerized person/avatar/embodiment/character. You can walk around, chat with other characters, explore dangerous areas infested with monsters, solve puzzles, and even create your own rooms, automata, and items.

1982 – The film “Tron” – the film mentions the Metaverse. According to the story, the main character becomes digitized and gets inside the computer, into a completely new world that does not completely copy of reality, but is filled with software abstractions with video game logic.

1984 – The novel “Neuromancer” – the story tells about the world of the near future, where people's bodies are covered with high-tech devices. William Gibson's fantasy warned the very essence of the Internet as a single space for data storage. After the release of the novel, the concept of “cyberspace” is popularized.

1999 – The film “The Matrix” – it describes the idea of what would happen if humanity existed inside a virtual reality.

2003 – The game “Second Life”, which had everything that surprised the Metaverse of the novel *Avalanche* so much. Players created their own zones with any rules and gameplay. Territories could be bought with money. Large organizations opened their branches in Second Life. At the same time, the economy remained quite free and the in-game currency was easily converted into a real one. In Second Life, you could do real business.

2006 – Roblox is a multiplayer gaming platform that surpassed 55 million daily active users in February 2022.

2018 – Ready Player One film, which takes place in the Metaverse. There the main character fights, plays, earns and loses money and communicates in the virtual world. He returns to the real world, rather, out of necessity.

2021 – Facebook becomes Meta (Figure 2).

Today, not only the Meta Company is engaged in the issue of building the Metaverse. Among the giants that are mastering the new direction are companies such as Amazon, Microsoft, Epic Games, Tencent and Roblox. Thus, Amazon has been working with augmented reality (AR) technologies for several years, from virtual trying on clothes to special glasses. Along the way, the development of software for cloud computing. And we are not talking about the company's smart home devices that can potentially be connected to its “system”.

Back in May 2021, Microsoft announced the creation of a corporate Metaverse. They are going to achieve this using the Azure cloud platform, which has services for creating a digital version of anything – from individual items to entire places. All this comes the interaction with the help of mixed reality. So, we can organize remote work or hold meetings with avatars of real people. Do not forget that there is also a gaming division with the Xbox brand in the asset, and some leaders do not hide: in the foreseeable future, entertainment applications and games may become part of the “universe”.

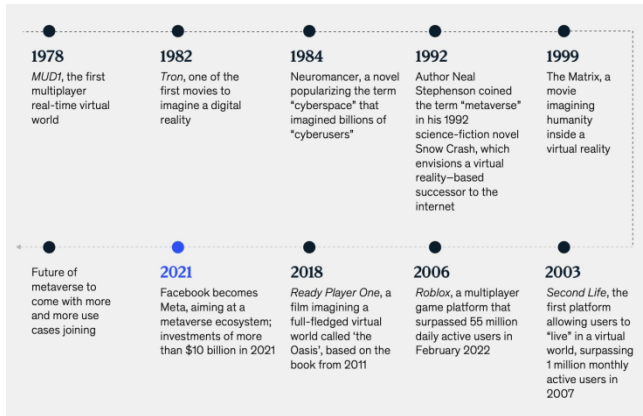


Figure 2 – Metaverse history timeline

1.3 Why metaverse? Why we need it?

Many writers, developers and metaverse fan believes that it can solve real problems of mankind. The main problems that will be solved by metaverse are listed below:

Problem 1. Users spend a lot of time on smartphones and laptops, and this affects health.

A sedentary lifestyle, many hours at the monitor, lack of real communication – all this leads, at a minimum, to depression and fatigue, and at a maximum – to real diseases and pathological conditions (physical inactivity, obesity, cardiovascular problems, headaches, visual impairment). In the metaverse, it will be possible to walk around the worlds, gesticulate, move objects with your hands. That is, our physical body will be in motion, which is vital. You don't have to choose between health and the possibilities of the Internet. In the metaverse, it will even be possible to do fitness in the gym among other people, or rather, their avatars. You will see the coach and other participants when you are at home, and they will see you.

Problem 2. People are less likely to communicate in real life, and more and more often replace voice communication with correspondence.

Another problem arises when children are given gadgets at an early age – they lose their motivation to explore the real world around them and communicate with their peers, instead they “stick” to Internet videos or scribble messages. Neural connections are formed more slowly, and this is bad for overall development. The Metaverse allows you not to lose your social communication skills. You can meet friends in a virtual cafe and communicate as if you met in a real cafe with your voice and expression of emotions instead of a couple of printed phrases and a Viber/Telegram/WhatsApp emoticon. When communicating on a mobile phone or even a video call, there is still no such effect of presence. You hear a voice or see a 2D image of the interlocutor, and in the metaverse you will have a 3D avatar in front of you, which you can even touch.

Problem 3. Distance.

We spend a lot of time to get to work, to the store, to pick up a package from the post office or to get to the theater. We may not see friends for years, because we live in different countries, and we simply do not have time. The Metaverse must remove these boundaries. In it, you can come to a virtual store, then meet friends in a virtual home (even if you live in different cities in reality), then watch a movie together, and so on. The time you save by doing the basic things in the virtual world (work, school, shopping) can be spent on something more valuable than standing in traffic jams. For example, for a real romantic evening with your loved one.

Problem 4. Pandemic.

In 2020, we all faced massive restrictions and were locked in our homes. Even in those companies where employees have been transferred to a remote location, some processes have to be solved offline, for example, hold a meeting in the office once a week. This is a risk for employees. Many people have been cut off from their loved ones due to closed borders [4, 5]. There will be no borders in the metaverse and there will be no need for QR codes to enter a virtual shopping center or meet a friend from another country (or rather, with his avatar, of course). There will be no need for offline meetings. You can get together with colleagues in a virtual room, present on a virtual whiteboard, and show digitized documents to superiors. Yes, this can be done now, but you must admit that a meeting in Zoom and a meeting in a large virtual room are not the same thing.

1.4 Classification of the Metaverses

Metaverses are divided into the following 4 main categories:

1. Traditional centralized Metaverses

These Metaverses do not integrate the blockchain into their mechanism and operate in a centralized system. In other words, these are virtual spaces controlled by a central organization that stores the data of all users. The advantage of these Metaverses is that they have the largest number of users. For example, the game Fortnite collects about 278 million users. For a brand that wants to bet on the number of audiences, this choice of the Meta may be logical. In addition to Fortnite, prominent examples of this group are: Grand the Auto V, Minecraft and Roblox.

2. Traditional decentralized Metaverses

This type of Metaverse implies virtual worlds in which all decisions are made by users through voting. Player data is not stored by third parties, but belongs to the account holders. At the moment, this type of Metaverse does not yet exist and most likely will not, since it is difficult to implement without the use of blockchain.

3. Blockchain based centralized Metaverses

The Metaverses create a complete digital economy where users monetize their acquisitions and creations. Meta data works with cryptocurrency, but user data is stored at the central organization – the developer. Metas of this type are at an early stage of development. Meta from Facebook can be attributed here, while it is under development.

4. Blockchain based decentralized Metaverses

In blockchain-based decentralized Metaverses, decision-making powers do not belong to the central organization, but to users. The so-called DAO (Decentralized Autonomous Organization) system operates there, in which each user who owns the Metaverse token plays a role in managing the virtual world in which he is located, and also follows the rules that are prescribed in the smart contract. Metaverses of this type are also developing a virtual economy based on cryptocurrency. This is probably the most successful form of the Meta, as the concept used most closely embodies what the Metaverse really is. The principle of decentralized Metaverses is an additional opportunity for the user to receive rewards with virtual items or currency. Exactly in these Metas the earning mechanisms such as “Play to earn” and “Create to earn” are most noticeable (Figure 3).

An example of this type of Metaverse is Axie Infinity, which is based on the Play to Earn model. The Decentraland and The Sandbox metas are also examples, but in a more traditional way, where users own land and can do almost anything with it. Brands are already actively using this type of Metaverse. For example, on July 12, 2022, The Sandbox and PlayBoY collaboration was announced, and on July 30, 2021, Coca-Cola's NFT sale took place in the Decentraland Metaverse.

In terms of functionality, all Metas can be divided into the following 3 groups:

- **Gaming:** this is the most popular and developed direction in the Metaverses. Given technology maturity, user fit and content adaptability, games are a great way to explore the Metaverse.
- **Crypto-worlds:** these are immersive virtual worlds with huge social and financial potential.
- **Business, work, and learning:** the Metaverse opens up new opportunities for immersive virtual collaboration in terms of remote work.

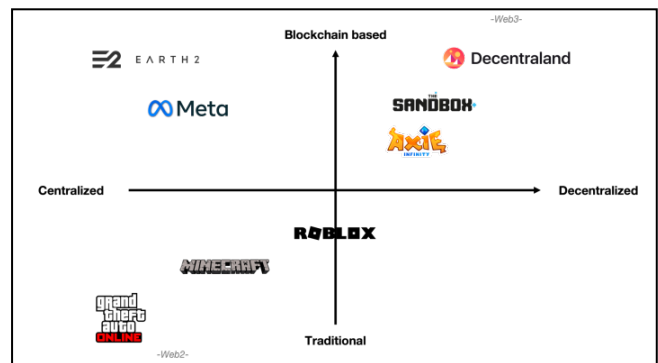


Figure 3 – Metaverse classification

We are, as architects, urban planners, or as an ordinary citizen, more interested in the later option, which affects the life of a greater number of the population. But it must be recalled that for all 3 categories, a minimum 3D designer and visualizer is needed, where professional architects and urban planners are more widely needed. Just this space should look and justify like the real world, and definitely needs all the details as it really does for the architecture and urban planning design.

1.5 How does metaverse even work?

Designing a metaverse is relevant in the educational and corporate environment, in the field of communications. We need 4 basic factors in order to realize metaverse working: software, equipment, data centers and blockchain.

- *Software*: With the help of 3D engines, projects of the virtual world are created. The most famous of this kind of platforms are Unreal Engine and Unity.

- *Equipment*: These are the user's guides to the metaverse. VR glasses, AR and XR gadgets, and in general everything that will help you interact with the platform. Virtual and augmented reality glasses are optional. The main thing is that the two universes unite, so that it can even be a sound reality without visualization.

- *Data centers*: These are cloud storages for the data of the metaverse, server and network equipment are placed here, and there is a connection to the Internet. The main suppliers are well-known companies such as Amazon, Google and Microsoft.

- *Blockchain*: This thing attaches the data and money of each user to his digital account and allows you to use the purchased products throughout the metaverse.

There are many collaboration and communication services: VR-Chat, Engage, Horizon Work-rooms, as well as games with sandbox worlds like Minecraft, Roblox and Horizon Worlds. However, all of them are still very far from a full-fledged metaverse.

The main criteria that officially presented to the metaverses are listed below:

- *Interoperability* – the ability to work on any device;
- *Decentralization* – independence from any particular company or server;
- *Persistence*, when the world lives its own life, even if you are disconnected from it.

Now companies are looking for solutions: some focus on decentralization and blockchain, others focus on immersive worlds. In the coming years, we should not expect a miracle – except for the active phase of investing in the metaverses direction. The popularity of Meta Quest 2 VR headsets is growing at a rapid pace, but to form the foundation of Meta's metaverse, it is necessary that these devices be in every home, by analogy with a computer or smartphone. There is also the question of available computing power – according to the statements of the CEO of Intel Corporation, there are not enough computing resources in the world to support worlds of this level of detail. And then there are legal and political aspects. The implementation of the Web 3.0 concept will be a global technological revolution that is revising most of the usual processes both on the web and in the physical world. The fact that not only users and centralized individual companies but also states become participants carries great risks. All parties will have to not only launch process updates in parallel, but also agree among themselves by linking their products, regulations and subsystems into a single network. The process of launching such a large-scale mechanism should greatly affect everyone without exception. If all this becomes a reality, people will have to find a balance between the virtual and physical world so that the metaverse does not become the reason for losing touch with reality.

2 From reality to virtuality

In the future, the matter will not be limited to one metaverse, the Metaverse world will be as diverse as the modern Internet. In fact,

Metaverse is the mobile Internet of the next version. Even if the Metaverse falls short of the vision of science fiction writers, it will generate trillions of dollars in profits as a new computing and media platform. If the concept of the Meta is fully realized, then the Metaverse will become the gateway to much of the digital “impressions” and “experiences”, as well as a key component of the physical world. The benefits of being a key player or even the driving force behind such a system are clear. Nobody “owns” the Internet today, but almost all of the leading Internet companies are in the top 10 most valuable public companies on earth. And if the Metaverse truly serves as a “successor” to the Internet – this time with even greater reach, user engagement, and commercial activity – there will be even greater economic benefits. It looks something like this: the user creates an avatar, gives it a certain appearance, then from his equipped virtual home goes to work in a virtual office, where he meets the avatars of colleagues [6]. Physically, they can be anywhere: lying in their favorite sweatpants on the couch or in shorts – on the beach of Sri Lanka.

Now companies that are interested in this area are developing devices for a more complete immersion in the metaverse world. The same Meta announced the work on a high-quality virtual reality headset – the Project Cambria VR helmet. He will be able to recognize facial expressions, read mood, understand the direction of gaze and form augmented reality in front of a person's eyes. The company is also going to introduce augmented reality glasses under the working title Project Nazare. They will be equipped with a holographic display, a projector, chips, cameras, sensors and speakers. Another example of an immersive augmented reality assistant is the Hololens AR headset from Microsoft. It tracks a person's gaze and hand movements to overlay virtual images and icons. This allows you to create usage scenarios – the glasses tell you how to navigate, identify objects and interact with the ordinary world in a virtual manner. However, these technologies are not enough. Epic Games founder and CEO Tim Sweeney explains that in the metaverse, users will be able to move from one world to another, retaining their appearance and objects, having different experiences of events, while remaining socially connected with each other. This requires a new programming model that will be like a live and open evolving platform where millions of users move seamlessly from one world to another. Such a model does not yet exist.

An example of how a blockchain-based metaverse works is the Decentraland virtual reality platform based on Ethereum. On it, users buy plots in the virtual world, communicate with each other through digital avatars and attend events created in this space. The blockchain-based experiment includes true ownership and gamified social functionality.

3 Virtual world to metaverse

The Metaverse is a publicly accessible virtual space within which people can interact with each other and with all kinds of digital objects using pre-created avatars. Such interaction becomes possible through the use of virtual and augmented reality technologies, as well as the use of special VR and AR equipment. In other words, plunging into the Metaverse, a person receives direct control over his avatar, after which he can perform all kinds of (and sometimes impossible) actions in a pre-created digital reality.

Theoretically, metaverses provide users with the opportunity to lead a full social life. They should have a developed economy for the possibility of mutual settlements, as well as thoughtful systems of virtual interaction and communication. Which excludes it from the true experience of the metaverse, so it's not a smooth movement [7]. You don't start in your house, on your land and go to the venue. You do not look into the distance and see the city spread out before you, ripe for exploration. This will be the next step. The Metaverse must bring it all together, group disparate businesses together, and create an experience that benefits the user both digitally and physically. If you need to go from home to the arena, meet friends along the way and use VOIP chat to communicate, this is one step. If you can buy an NFT poster for your digital bedroom when you arrive, as well as a T-shirt for your avatar – all from a digital avatar vendor – it would be helpful if the physical versions of them were sent to your home.

4 Effect of Digital on real architecture

There is no traditional constructive logic in the metaverse, and sometimes you can even change the physics, allowing avatars to jump 10 meters up and walk on the ceiling. Such conditions for creativity will create a new quality of architecture, which, will move from virtual to physical architecture. For those who believe that you can become a real architect only if you build and work with materials, let me remind you that many great architects developed their style and approach precisely on virtual projects – you can remember Cedric Price's Fun Palace or Bulle's utopian projects and Ledoux. Architectural discourse has been in crisis for the last 20 years, because there are no significant, transformative trends. The Metaverse is a new approach, new opinion leaders. Very soon they will create a new visual language, the quality of spaces and change styles.

The Metaverse can also be viewed as a digital layer that is superimposed over the city and read using, for example, a smartphone [8, 9]. Therefore, buildings should have a set of elements that would help not only human vision, but also machine vision: there are already unmanned vehicles, drones and robots that can deliver and other services. In the longer term, the boldness and madness of architects in the metaverse will introduce a new visual habit in humans that will affect the architecture of the physical world. Now the metaverse can serve as a platform for testing ideas that will later be embodied in the physical world. Zaha Hadid Architects designs Liberland's master plan and public presentation spaces.

The digital world should become an experimental space for rethinking what we build in the physical world, taking into account the global impact of the construction sector on the environment. Moreover, the metaverses are more inclusive due to their accessibility and enhanced functionality.

5 Role of an Architect in Metaverse

In the modern world, technology companies drive progress, but they are guided by their markers of success: the number of purchases made, the amount of time a person spends on the page, and so on. Acting in their own interests, they can create an environment that is not oriented towards generally accepted social values.

Historically, cities developed spontaneously, but now we are well aware of the problems of self-building, favelas and poor urban planning. Architects must take responsibility for what is already happening in the metaverse, try to create an architectural correction environment there. There are three components necessary for the existence of the metaverse. *The first is the world*, context, three-dimensional space. *The second is the avatar*. And *the third is content* that can be located inside the space and with which the avatar can interact. All these components will be modernized, supplemented, subcategories will appear, but the context will remain the most ambitious and significant. Just like an architect in the physical world, an architect in the metaverse will be able to influence the experience of an entire group of people within a space. The stage of mimicking the physical world should pass quickly or occupy a small part in the architecture of the metaverses, since the challenge lies in new materials, tools and the absence of most of the limitations of the physical world. Now most of the things that have been done are already done by game designers.

The current metaverse prototypes are often similar to cities: the same public spaces, areas that can be built on, buildings, parks and streets. Now it's voxel geometry and low-poly aesthetics – architects are used to a different concept. At the same time, the digital world does not shackle us with norms or physical restrictions, building codes and budgets. In a digital world, the important thing is: "how you work with geometry?"; "how you can optimize it?"; and "what narrative you offer to the user?".

Architecture for the metaverse is open to all users, but freedom of expression in the metaverse comes with its own challenges. Architects are faced with the task of developing systems of interaction and control so that the new quality of the Internet does not turn into chaos. Now technology companies themselves are trying to solve this problem, sometimes involving users, but this is clearly not enough. Architects will have to come up with a language for this digital world. There will be copyright spaces that

collaborate with architects, but there will also be spontaneous ones. It is necessary to transfer the expertise of architects to the metaverse.

6 Metaverse and City

As we know, pandemic situation in 2020 have many negatives on humans' life, but it helps to know and review many things and daily manner in our life like as: our health and take more times for ourselves, family, close friends, walking, shopping, study, working etc. Without a doubt, COVID-19 had a powerful impact on some of the innovation development and digitalization like as: online commerce and robotic delivery, electronic and contactless payments, remote work, distance learning, telemedicine, online entertainment, supply chain 4.0, 3D printing, robotics and drones, 5G and information and communication technologies (ICT) [4, 5]. This list certainly accelerated the emergence, appearance and needs of the metaverse in the present.

Today, there are a large number of separate metaverses in the world. The first and most famous ones are developing on the basis of games (Fortnite, Roblox), gamified blockchain projects (Decentraland) or work-spaces (Horizon, Microsoft mesh), which have become necessary since the beginning of the pandemic. But speaking of the metaverse and the unified 3D internet, it is impossible not to talk about cities and the integration of public services, as well as the emerging desire of the authorities of different countries to develop digitalization, laid down by the concept of a smart city and to use the opportunities that the metaverse will provide.

Dubai, Abu Dhabi, and Seoul could be the first cities to appear in the metaverse. Previously, developers created only fictional worlds or individual fragments of real cities, but now they expect to recreate cities, respecting the real scale of buildings [10]. Users will be able to visit cities for the purpose of tourism or shopping, as well as receive public services there. However, experts doubt that they will become popular: it is easier to get banking or government services using the site, and such tourism will become more prepare for a trip than a full-fledged replacement.

The beta version of the project Metaverse Holdings for Dubai and Abu Dhabi is planned to be launched at the end of 2022, and soon after that it will be available to users around the world. The company said: Unlike existing VR projects, where developers create small fantasy worlds, this metaverse will be based on the real world. After the launch of the beta, the metaverse will also recreate the key places of the UAE, which will be "visually, topographically and geometrically" correctly correlated with real objects. Users will be able to visit the metaverse using a VR headset, an application on a smartphone or other device. According to Karin Neidu (strategic advisor at Metaverse Holdings), among the candidates for digitization after the launch of the UAE are Saudi Arabia and Qatar.

The main opportunities of the metaverse for city dwellers consisted of:

- *Availability and effectiveness of the services received:* First of all, this is an opportunity to get more services without a personal visit to various institutions and with great immersion. This, for example, concerns such areas as education and tourism. Of course, we would prefer to do both personally, but the metaverse is able to make these areas more accessible (no need to travel to another country to attend the event). Compared to existing digital tools, the metaverse will provide a livelier communication and presence effect. Video broadcasting an event or recording a lecture and being in a virtual 3D environment is not the same thing. The presence in space (even if it's virtual space) creates a brighter image and contributes to better memorization of information.
- *A new layer in the urban environment:* The digital layer is perceived through glasses. I wanted to play chess with a friend, found any free table and move virtual pieces around the virtual field. User could upload a street design created by another user and now instead of a gray fence you look at an animated painting. Creating content and making it easier to influence the environment around you is another plus. Influencing space on the virtual layer is the realization of the values inherent in civic activism and participatory design – in order to feel like residents and owners of their area, city and people take part in its development (Figure 4).



Figure 4 – New virtual layer in the urban environment (concept)

7 Metaverse cities realization samples

The government of various countries is interested in the development of their own metaverses. The following are working on the creation and financing of local platforms:

- The United Arab Emirates – the government of the country announced the launch of the “Dubai Metaverse” strategy. With the help of it, 40 thousand specialists will be attracted and new platforms and technologies will be developed.
- China – The government of the country plans to create its own controlled metaverse. And Hong Kong and Shanghai are already busy developing their own virtual reality educational platforms.
- Spain – The government of the country has allocated \$ 4 million in grants for the creation of the metaverse. And Catalonia is busy building its own CatVers platform.
- South Korea – the government of the country in 2022 allocated \$ 177 million for the development of the sphere. And Seoul has been building its own Metaverse Seoul since 2021.
- Indonesia – The government has already launched its own Meta-Nesia platform. Events from the real world are planned to be transferred to the metaverse.

Seoul – South Korea

The city of Seoul (the capital of South Korea) announced that it would become the world's first “metaverse metropolis” at the end of 2021. As part of the project – tentatively titled “Metaverse Seoul” – regulators will create a communications ecosystem for all areas of urban life. Quartz reports that the initiative involves the launch of a virtual version of the city, which can be accessed by any inhabitant of the planet using a computer or VR glasses, reports.

The Seoul Metaverse is not an entertainment project, in the manner of VR playgrounds, but part of South Korea's plan to reorganize the economy amid the pandemic. The development of a digital reality includes economic, cultural, tourism, educational and civic services, which will begin to roll out from next year. At the same time, the first Metaverse Seoul structures will start operating at the very end of 2021.

The pilot program will be presented as a virtual bell at the Bosingak Belfry. Traditionally, this bell is only rung at midnight on New Year's Eve, but this time it will ring twice at the same time – in the real world and in a virtual replica of the historic building. The event will mark the start of the new calendar year and the official launch of Metaverse Seoul. Later, the city government will partner with the private sector to help digitize real-world services to support businesses and consumers through virtual reality. Regulators will “build” a virtual city hall, a laboratory for creating new financial technologies, a replica of the Invest Seoul investment fund, and a Seoul campus city. All structures will work at the state level – residents will be able to turn to politicians on issues that concern them and solve them without leaving their homes. In 2023, “the Seoul Metropolitan Government (SMG)” will open a virtual community service center, the Metaverse 120 Center. Officials will communicate with visitors to the center in the form of avatars, providing advice that was previously only available through the Seoul City Hall center.

Major tourist attractions in Seoul, such as Gwanghwamun Square, Deoksugung Palace, and Namdaemun Market, will also be introduced through the “Virtual Tourist Zone”. Within two years, key events in the city, such as the Lantern Festival, will begin to take place in the metaverse and can be accessed from anywhere in the world. Moreover, the metaverse will help South Korea in the process of recreating the cultural heritage – Donuimun Gate, one of the city's gates to the capital, destroyed in 1915, will be transferred to the virtual space in its original form. In parallel with tourism activities, SMG will develop services for socially vulnerable segments of the population. Mixed reality (XR) systems will help people with disabilities receive medical and psychological consultations, as well as allow access to places that were previously inaccessible to people with disabilities.

The city government will use part of the \$3.3 billion allocated by Mayor Oh Sehoon for the 10-year plan to modernize Seoul to create the metaverse. Hong's strategy is to create a “digital course for Seoul” – the authorities want to improve the health care system, education and tourism industry, as well as accelerate the development of the economy and introduce a new type of public transport – electric air taxis into everyday life.

Dubai – UAE

In the summer of 2022, the United Arab Emirates announced the launch of the Dubai Metaverse strategy. Within 5 years, the government plans to develop platform standards, introduce new technologies and create infrastructure for the metaverses.

The goal of the program is to develop this area and attract new professionals to the Dubai metaverse. In five years, the authorities plan to attract 40,000 developers and content creators of digital platforms. For the development of the metaverse, the UAE is ready to hire local and foreign specialists who will work for technology companies in Dubai. In 2022, more than 1,000 companies were registered in Dubai that are associated with the metaverse. They have already brought \$500 million to the country's economy. The government plans to increase this figure to \$4 billion. The Dubai Metaverse strategy also has the task of integrating the technologies of the metaverse into the daily lives of citizens. Therefore, the government of the country is developing its own state platforms. For example, at the beginning of 2022, the Arab Health and Medlab Middle East 2022 congress was held in the UAE. At it, the Minister of Health introduced the first customer service center in the metaverse. Users of the MetaHealth platform will be able to communicate remotely with the center's employees and draw up documents. Public services can be obtained from any phone or personal computer. As a rule, public and private organizations do not engage in the development of the metaverse on their own, but turn to agencies specializing in the metaverse. They help to most accurately adapt the concept of a downloader to the possibilities of the metaverse and have the expertise necessary in such a rapidly changing market.

DEIP Metaverse City

At the beginning of June 2022, DEIP Metaverse City opened a space in the metaverse for the creative industry. The project brought together artists from all over the world and showed how you can present your art using DEIP technology, one of the first Web 3.0 creative economy protocols.

The author of the digital activation (BALAGAN team) in collaboration with the Arhead.io metaverse ecosystem and the Atrium architectural workshop creators created a city that reflects the values of DEIP in virtual architecture. The project team designed everything from buttons and avatars to buildings and plazas, integrating the branding and color palette into texture and lighting. The basis of DEIP Metaverse City was the rethinking of microchips – those same ones thanks to which the technologies of our devices work.

DEIP Metaverse City consists of five locations: a three-story exhibition area, a labyrinth with dozens of intersecting streets, as well as tunnels and a square with an amphitheater. The main attraction is the Balloon Dog (Blue) installation by Jeff Koons, one of the most expensive American artists whose work can be seen today in leading museums of contemporary art (Figure 5). The sculpture, donated by the Swiss gallery Weng Contemporary and converted into a digital format, was the first piece of art to be officially presented in the DEIP metacity. There are other exhibits in the space: Venus of Willendorf, Nika of Samothrace, Kazimir Semenovich's multistage rocket and Miron Kruger's sensors.

At the very beginning, visitors are greeted by a huge avatar – DEIP Executive Director Alexa Shkora. He accompanies guests throughout the journey: he talks about locations, mechanics and plans for the development of the creative economy. The culmination of the trip is a ray of light launched by the guests over the metropolis, marking the opening of the

mainnet (blockchain for monetary transactions). As Konstantin Belyakov, cofounder and creative director of Balagan, noted, more than 70 world media outlets interested in the future of blockchain and the creative economy wrote about the project: “It was important for us to contribute to the development of the creative industry, as we ourselves are its representatives”.

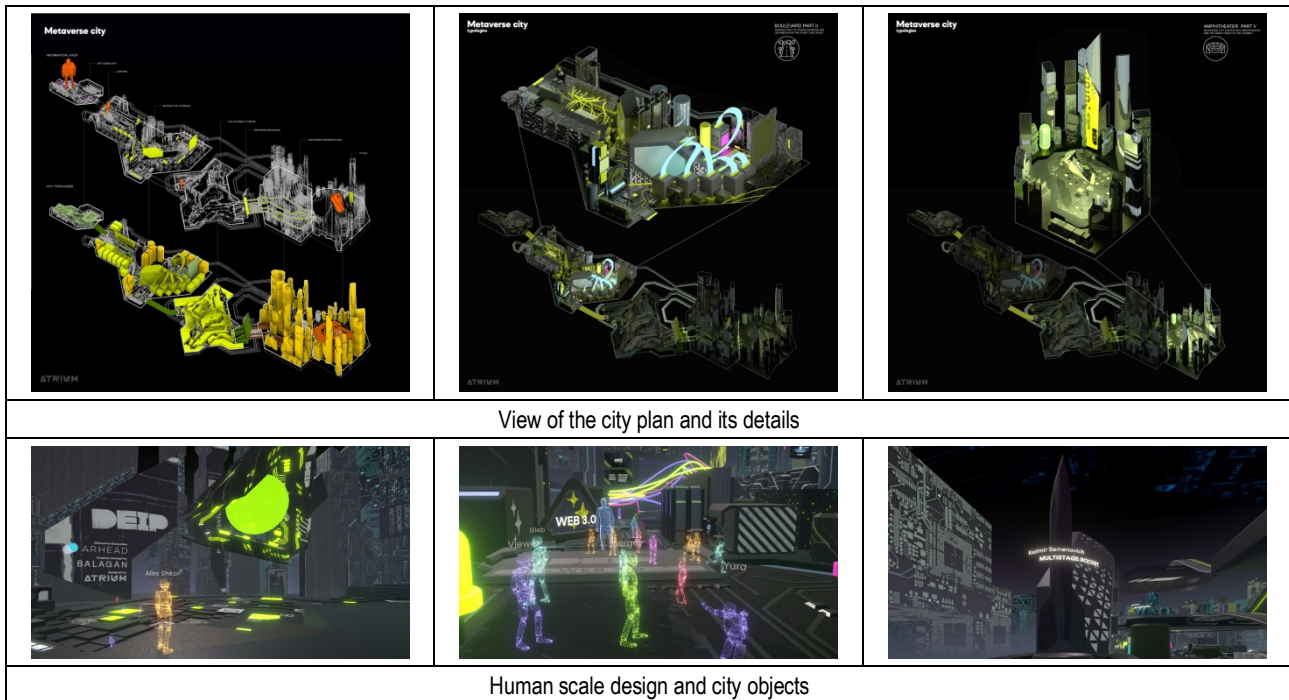


Figure 5 – DEIP Metaverse City and its details

From the exact vision of other professionals this city can beat very well and generally in today's day is excellent for the creative industry. And there are other sides to see the architecture and urban planners, and their opinion. As can be seen from this sample and the details of the city, many objects of the city and architectural objects and details are missing. Many say this space is too fantastic and generally without green territory, which really influences the soul of a person and his psychological health and character. If we understand this space as a world that a person will participate in a lot of time and life, then the scale of the future problem that connected with these spaces will be great.

8 Metaverse and Sustainability

A review of the literature and the direction of the metaverse of the city proves the presence and existence of a strategic plan for cities within the sustainable development of the city. Thus, if this strategy beat sustainable development in the 90th year, then in 2000 until 2015 the strategy received a green or smart city, and so on until today, which is the metauniverse city [11, 12]. Obviously, this process is the continuation of the sustainable development of the city, country, nation and humanity. Therefore, the effect of metaverse on 3 main aspects of sustainable development considered below:

Social aspect: if we look at the deeper underpinnings of these trends as sustainable development, we can say that the Metaverse is indeed influencing the social development of citizens, since this pace has received more support in the time of the Covid-19 pandemics in 2020. Moreover, this direction will develop on social networks and communication basis, then we can say that this direction affects the social aspect of sustainable development. There is also a well-known term called metamedicine, which is not limited to the consumption of goods in virtual reality and extends to other areas. For example, prescription games and digital medicine become possible, that is metamedicine. In addition, the emergence of “VR pharmacies” for the treatment of certain diseases is possible.

As part of the direction of metamedicine, games for treatment will develop; VR pharmacies and prescription games may appear. For example, in June 2020, Akili Interactive's game EndeavourRx was approved by the Food and Drug Administration (FDA), making it the world's first video game for treating attention deficit disorder in children. In 2021, the game will be tested as a treatment for COVID-19 patients with brain fog¹. Revery raises \$2M in 2021 to improve mental health through mobile gaming technology. The project will launch an app that combines cognitive behavioral therapy for insomnia with mobile game concepts. Virtual communication plays an important role in the formation of metalife. According to a Wunderman Thompson report, 83 % of consumers globally believe technology brings people together, while in China, 84 % say technology has strengthened their relationships with friends and family. In particular, games are becoming key places to meet people.

In addition, in the metaverse, virtual platforms are used for large-scale events and small meetings, land is being zoned and sold, plots and houses are purchased, trips with the full effect of being present are possible. New social networks are being created and united by shared values. In particular, IMVU (Instant Messaging Virtual Universe) from Together Labs is a social network for finding friends based on 3D avatars. IMVU is becoming a place to express yourself and build a community.

Economic aspect: many literary analyzes and leading directions say that so far investors are coming to the metaverse only for economic interest. Then the metaverse, as a new developing trend and direction of business, affects the economy.

According to a 2021 report by research firm Technavio, the in-game advertising market will grow by \$10.97 billion between 2020 and 2024. This growth is fueled by brands building their gaming know-how and incorporating gaming experiences into entertainment and advertising strategies. So, Balenciaga released a 2021 collection with the debut video game Afterworld: The Age of Tomorrow, created by Streamline Media Group. Players navigate the futuristic world as they pass other characters dressed in the brand's new designs. In addition, marketing opportunities will expand and new business models will appear for assessing the demand for virtual things, predicting the quantity, time and place of production in the physical world.

Environmental aspect: as they were impoverished earlier, at the expense of less leaving home and using transport at the expense of household, educational and work processes "at a distance"; the metaverse affects the ecological aspect of sustainable development.

No need to score smart and green city direction according to how much this trend is based on the development of the Internet, information analysis, convenient and efficient system for serving the city population, then the metaverse city is an advanced version of the smart city. The metaverse will be more active and accessible to smart populations. In the coming years, the world will become even more virtual, changing everything from fashion to finance. In addition, there are near-term break-throughs in clean technologies and bioengineering, which could help make progress in tackling climate change and curing disease.

9 Main advantages of metaverse

At the moment, the metaverse for architects and urban planners is playing a new trend and opportunities for 3D visualization, 3D designs and their expansion.

On the other hand, the metaverse facilitates the land and transport restrictions of the city due to the possibility of services and virtual spaces. There is such doubt and criticism that the metaverse reflects realities and limits our vision to what we can imagine [5]. In response, it must be reminded that the metaverse is a choice, and not an obligation for each person. Literature reviews shows main advantages and opportunities of metaverse as below:

- This is communication from any corner of the world; and the ability to meet friends and colleagues in virtual worlds, instead of wasting time on the road.
- The ability to transfer many household processes "to a remote location".
- New working format.
- New jobs will appear, for example, programmers and designers of virtual objects and meta-worlds will definitely be in demand.
- The ability to visualize their projects, for example, inventors will be able to show investors prototypes of their developments not just in the form of drawings or printed 3D models, but as an object of the virtual world.
- It can also change the scope of education and more study opportunities: in history lessons, children will be able to find themselves in the virtual world of ancient Greece or visit the battlefields, medical students will be able to practice and study anatomy on virtual models of people, future architects will be able to create full-sized virtual buildings.
- It could engage virtual influencers and models.
- We can open a shop there.
- New advertising system and platform.
- We can implement outdoor advertising.
- We could hold events and concerts.
- Advertising, buying, Selling Metaverse Objects and Investing.
- Erasing boundaries, the ability to travel through virtual worlds. This will make life easier and better for people with disabilities, low financial status or those who cannot travel due to restrictions imposed by the state.
- And of course, you can create your own universe and make the space branded, sell your services in the virtual world and communicate with customers through such an unusual communication channel.

10 Disadvantages and risks of metaverse

Despite the optimism of the ideologues of the metaverses, many unsolved questions remain. Because of them, the creation of a full-fledged virtual universe will stretch for several years. The main unsolved questions category listed below:

First of all, related to technology: now VR glasses and tactile gloves are heavy and uncomfortable and it's hard to stay in them for several hours. Some users get seasick when they use standard VR glasses. Mark Zuckerberg believes that these should be glasses that are close to ordinary glasses for vision, like Google glass. More compact and light weight counterparts are needed. In addition, while the quality of graphics in the VR environment leaves much to be desired (although progress is already noticeable). To feel completely immersed in the process, it is important that we see with our own eyes – a realistic 3D avatar or a pixelated man with a triangular head.

The second point is the safety of the physical body while traveling through the metaverse. A person in a VR helmet can easily trip and hit the furniture in their apartment. So, in addition to diving equipment, there must also be safety equipment. As an option, use virtual reality running platforms like Virtuix Omni 2.0.

The third point is internet. Life in the metaverse requires stable Internet access. But for many users, this is a problem, which means that these people will be cut off from the opportunity to settle in the metaverse.

The main disadvantage: Metaverse is not equal to the transition from reality to virtuality! The advent of online services has not made our streets empty, we still go to sports clubs and group workouts, watch movies in cinemas eating popcorn and personally go out for buns in bakeries. What has changed is that in a situation where you prefer to save time on the road, or today is the day when you don't want to leave the house and smile at neighbors and sellers, you have this alternative. The emergence of the metaverse does not necessarily pull us further from reality. The development of the Internet and Internet services is due to convenience and efficiency, so that a person can spend less resources to get the result, changing the quality of the process. The metaverse faces the same task – to make it possible for people to solve the problems facing them even more effectively. We are already spending the time that we will spend in it online; in some professions, working hours will be added here. "To what extent are existing projects coping with this", that's another question, but we have to start somewhere.

Risks

The risks of the metaverse are associated with the desire of users to transfer their values and ethics to the virtual world, and their real identity will have an impact on the physical world and have real negative consequences.

The transformation of perception has a significant cultural impact on society and changes in behavior in society, including the reduction of the importance of morality and ethics through the use of a virtual avatar. This is especially true of the most vulnerable new group in the metaverse, children. In addition, there is the problem of respectful interaction with intellectual property and the use of content.

Another category of risk is associated with the implementation of legislative initiatives in the metaverse and legal jurisdiction, due to the lack of physical boundaries for supply chains that are not regulated by tax codes and regulations. The most important issues relate to the regulation of interaction in the metaverses, which open up new opportunities for manipulation and misinformation, shifting landmarks and changing the perception of the surrounding world.

Results

Based on the summary of this study, the following results can be drawn:

1. Digital future, what we once read about in science fiction writers and postmodernists has already become our new reality, and the government is discussing not only cryptocurrencies and mining, but also cybersecurity in the metaverses. There has been a lot of talk about the metaverse since Mark Zuckerberg announced at the end of 2021 that Facebook was renamed Meta and the company was focusing on virtual products. In the Metaverse digital space, a user can be anyone, choose their appearance, contact other players (their virtual avatars) and objects. It is important that the metaverse has all the attributes of the real world, where it has its own digital economy, which allows you buy clothes, real estate, including NFT objects, go to exhibitions, concerts, have parties, watch movies, and much more. Metaverse should become a single virtual ecosystem where all the above principles will be implemented.

2. It seems metaverse would be a good new approach and opinion for architectural discourse. Some scientists believe metaverse is a continuous approach of sustainable design and smart urbanism. Although this area is open to all, but freedom of expression in the metaverse comes with its own challenges. Some architects try to design master plan and public spaces for metaverse.

3. Pandemic situation in 2020 helps to know and review many things and daily manner in our life, and powerful impact on some the innovation development and digitalization and finally accelerated the emergence and needs of the metaverse in our life and city. The main opportunities of the metaverse for city dwellers are: availability and effectiveness of the services received and a new layer in the urban environment.

4. The implementation and plan of the Metaverse City more supports the idea that the Metaverse is a new trend/direction of sustainable development or a smart city, according to how much such an approach has been implemented in cities that have smart city infrastructure and a plan for the implementation of sustainable development aspects.

5. A review of the literature and the direction of the metaverse of the city proves the presence and existence of a strategic plan for cities within the sustainable development of the city.

6. The risks of the metaverse are associated with 3 main criteria (desire of users, cultural impact on society, legislations) that affect the physical world and have real negative consequences.

7. Technology can lead to new mental health issues, an increase in addicted users, an increase in cybercrime, a threat to data and privacy. The list of cons also includes a possible seizure of power by corporations within the platforms. At the same time, the emergence of the metaverse will open up many opportunities: a new level of communication, increased social interaction, increased levels of digital empathy, and improved work processes. In addition, new professions will appear, which will create jobs, and education can move to a completely different quality level.

Conclusions

The concept of "metaverse" implies the presence of a new digital infrastructure, which is similar to the Internet and is located in the virtual world. The possibilities of the metaverse apply to all areas of users' lives and offer new options for using virtual reality. In particular, the average user's metalife paradigm needs to take into account consumption, medical care, travel, work, dating, and communication. Virtual communication plays an important role in the formation of metalife, and created a new social network, which united by common values. In addition, in the metaverse, virtual venues are used for large-scale events and small meetings, land is zoned and sold, plots and houses are purchased, travel with the full effect of presence is possible.

The Metaverse is a huge simulation. It cannot completely replace the real world and it's not meant to be. The metaverse will become a continuation or addition to the real world with all its pluses, and for some minuses. If it is implemented as they are promised, it will be a breakthrough in virtual and augmented reality technologies and change the fate of many people. The general understanding from the metaverse is to say that this new trend does not actually reconstruct cities, but on the contrary, a new function of reality appears in the city that people want to see it. Ultimately this should make cities more livable. Will the developers succeed in creating a metaverse or will it remain an unrealizable fantasy – we will see in a few years.

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