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Platformization and the Metaverse: Opportunities and Challenges for Urban Sustainability and Economic Development

Aram Mohammed-Amin Qadir, MSc[1], Ava Omar Fatah, PhD.[2,*]

[1]Department of International Trade, Law and Administration College, University Of Halabja, Halabja, 46018, Iraq
[2]Department of Marketing Management, College of Administration and Economics, University Of Sulaimani, Sulaimaniyah, 46001, Iraq

Abstract

In simpler terms, our day-to-day life, from various urban sectors to all deep corners of city life, is becoming hugely influenced by digital platforms' data systems, economic tactics, and ways of management. This is a trend that we call "platformization." It's taken us to a point where we now live in what's often described as a "platform society" because these platforms now largely control urban civilizations. What's fascinating is that this platformization trend has created something pretty striking: the Metaverse. The Metaverse is an impressive global platform project launched by Meta, the company we used to know as Facebook. This project brings to life a potential "virtual world" that mirrors our reality. The idea is that the Metaverse can serve as a virtual version of the future cities – not too different from what we think of as smart cities. Thanks to cutting-edge technologies like Artificial Intelligence, Big Data, Internet of Things (IoT), and Digital Twins, we now have enough resources and understanding of human behavior to make a project like the Metaverse possible. The promise is that the Metaverse can revolutionize how we design cities and deliver public services, making cities more efficient, accountable, and with a higher quality performance. But of course, the arrival of the Metaverse isn't without its worries. There are many questions over the ethical, human, social, and cultural implications the Metaverse may have. Particularly, there are concerns about the kind of impact it may have on the quality of human social relationships and how it may reshape urban life. To unpack all of these, this research work aims to thoroughly examine available literature on this topic. The paper further looks into the new products and services coming into being because of the Metaverse, examining how they might help smart cities, especially those aiming for better environment, economy, and social sustainability. The insights gathered here could help city leaders understand the Metaverse's potential for technology-driven urban practices and future city plans. It also takes a critical stance, challenging whether the Metaverse might significantly change how reality is constructed in our increasingly platform-driven urban world. This discussion, hopefully, can fuel future research and critical conversation on this hot topic.

Keywords: Platformization; metaverse; smart cities; digital twins; Economic development; Digital platforms; Data-driven urbanism; Urban sustainability; digital economy; climate change; virtual reality

Received on 21 February 2023, accepted on 15 August 2023, published on 6 September 2023

doi: 10.4108/ew.3842

*Corresponding author. Email: ava.fatah@univsul.edu.iq

1. Introduction

Although not a new idea, the concept of the Metaverse is now gaining increasing attention due to its endorsement by 'Big Tech' companies like Meta. With its recent rebranding, Meta has not only highlighted its interest in the Metaverse but also signposted a significant redirection of its resources

toward the enhancement of virtual, augmented, and mixed realities. In our current times, marked by the rapid digital transformation instigated by the COVID-19 pandemic, other tech enterprises are also investing heavily in these digital future frontiers. The expectation is that these technological advancements will ubiquitously influence how people globally operate, whether in their personal lives, work environments, or recreational activities. Technological breakthroughs have chartered the course of the past decade. These advancements have been considerably influenced by the fourth industrial revolution, which in a cyclical pattern, in turn, got a significant stimulus from our forced inactivity due to the COVID-19 pandemic. Predominantly among these emerging technologies, Virtual Reality (VR) has found a robust growth pathway, nurtured further by parallel advancements in AI, the Internet of Things (IoT), Clouds of Things, Big Data, and others. Adopting and incorporating digital technologies in various spheres worldwide have earned digital approaches significant ground. This trend initially triggered as a response to the changing norms due to COVID-19 pandemic, had started manifesting in urban environments well before the pandemic through initiatives like the smart city project (Sharifi et al., 2021).

However, the pandemic has indeed pivoted us towards new digital working norms globally and made VR/AR technologies appear as plausible solutions to maintain effective functionality (Taylor & Soneji, 2022). Tracing the flip side of this coin, however, reveals challenges concerning data policy and privacy. These challenges have exploded with the rapid and widespread use of big data technologies, driven again by the pandemic (Li et al., 2022). There is also scepticism and interrogation revolving around the practical effectiveness of these technologies - many of which have been applied for data and geo surveillance (including biometric wearables, facial expression recognition, smartphone apps, smart helmets, and predictive analytics). Questions arise concerning these technologies' ability to effectively handle the pandemic situation (Bibri & Allam, 2022, Kitchin, 2020). Essentially, while the deployment of these technologies has allowed for better tracking, it has also entitled the state with unsettling monitoring powers, raising concerns over potential violation of human and civil rights under the pretence of public health. In particular, the fine-grained tracking and tracing technologies used intensively during COVID-19 substantially led to the compromise of human rights and civil liberties (Sekalala et al., 2020), a testament to the need for a human rights framework to protect the public from potential regulatory overreach.

The Metaverse project, initiated amidst the turbulent context of the COVID-19 pandemic, invites a blend of heightened suspicion and curiosity. This climate of uncertainty has seen the docket classified as an opportunistic exploit to alter the world's existing structures (Bibri & Allam, 2022). The stark, socially distanced "new normal" precipitated by the global health crisis has incited a drastic digital metamorphosis of urban societies, propelling us towards an era of integrated digital and physical realities. Unprecedented alterations in societal behavior patterns have emerged across a myriad of areas, including human interaction, occupational practices, travel, leisure, and interpersonal communication - all of which have been digitally redefined. Technological advancements have indiscriminately aided enforcement entities in the execution of lockdowns and movement restrictions, primarily in densely networked urbanities. Notably, 5G connectivity and the anticipated 6G technology are positioned as pivotal components in realizing the Metaverse (Allam & Jones, 2021). Nevertheless, these wireless technologies are not devoid of severe health risks and potential fatalities, as affirmed by numerous sector specialists. For example, over 250 European Union-based doctors and scientists vocalized concerns about the health implications of 5G technology in 2017, advocating for a moratorium on its rollout (Cassauwers, 2019). Zuckerberg (Meta, 2021) acknowledged that substantial financial and material resources would be necessitated to actualize the Metaverse, potentially alluding to the health concerns pointed out by the aforementioned experts. The financial aspects of the concept have already drawn significant attention, with virtual digital product consumers having reportedly spent thousands of billions already. For instance, in gaming, users often purchase various digital accessories for their online 'avatars'. The value of the Extended Reality market in 2020 is estimated to hover around 26-33 billion USD (Mordor Intelligence, 2023). Predictions for significant growth surface as commercial interests in the technology rise, forecasting a possible surge to around 125.2 billion USD by 2026 (Reality Market, 2023). However, garnering universal approval from disciplines outside tech, such as urban planning, will require significant technological and financial investments. Indeed, Meta's rebranding and strategic redirection towards the Metaverse underscores the global implications this concept portends. It implicates substantial shifts in governance and policy structures and a reevaluation of societal acceptance of this burgeoning technological frontier.

Smart urbanism and platform urbanism both play significant roles in contemporary urban development. Over the past two decades, the concept of platform urbanism evolved from smart urbanism (Bibri et. al, 2022). Smart urbanism leverages technology, big data, digital flows, and networked systems to effectively govern and provide urban services (Bettencourt, 2014; Bibri, 2021). Platform urbanism, on the other hand,

focuses on initializing new digitally driven socio-technological assemblages for transactions and intermediations within the urban environment (Caprotti et al., 2022).

Another vital term to understand in the discussion of platform urbanism is 'platformization.' It refers to the integration of infrastructures, digital platforms, and economic processes in several sectors and life spheres, ultimately reshaping cultural practices and imaginations around such platforms (Dijck et al., 2018). The advent of platformization has led to what is now termed 'platform society', where there are intense struggles among government bodies, market forces, and civil societies. These different entities have contrasting ideologies about managing and preserving the common good and societal values within a platform society (Dijck et al., 2018). Furthermore, the development of the Metaverse, a realm of virtually created urban spaces has seen tremendous attention in recent years. This progress has led to the labels “virtual urbanism” or “augmented urbanism” (Gordon & Manosevitch, 2010; Wilkins & Stiff, 2019). Here, urban planning, design, and geography are highly considered in augmented and virtual spaces. Part of the Metaverse-related activities includes data harvesting and modeling. These help urban planners enunciate and tackle existing and emerging city problems through city and data mapping. The findings further influence policy recalibrations in line with the smart city concept (Ameer et al., 2021) and various others, like the '15 minute city' concept (Allam et al., 2022) and the 'data-driven sustainable smart city' concept (Bibri, 2021). Smart and platform urbanism advancements have revolutionized urban development, leading to various innovative approaches to city governance and service delivery. These concepts underscore the importance of data and digital technologies in shaping our modern cities.

In the COVID-19 era, there is a growing consensus about the importance of proficiency in digital and computing technologies. This is especially pertinent as numerous city economies and urban societies are reevaluating and restructuring their economic and social visions. The pandemic has significantly altered how city governments devise economic support packages and mechanisms along with changes in the distribution of rebates and taxation arrangements and healthcare, social, and physical infrastructure funding, much like the 1918–1920 Spanish Flu aftermath. During this time, many nations adapted to a new normal that was specific to their nation's context while also adapting to the yet to be defined global new normal (Allam & Jones, 2020). However, these narratives have been contentious. For instance, the Metaverse, can be perceived as an imagined representation of urban worlds, offering insights about future possibilities and potential hurdles. These depictions offer various perspectives on how the future is being conceptualised, influenced, and framed (Miles, 1993; Lawler, D.L, 1980; Popper & Rafael, 2009; Miles, 1990; Salerno, 2014). Existing literature has explored how ICTs contribute to the formation of new urban ideals and ideas, by examining the new ways they are used and the concepts they give rise to. Bibri's recent work (2022) contributes to the discourse by extending the social scientific critiques of the imagined facets of smart cities through an analysis of the Metaverse as a series of imagined representations and the urban worlds it promotes. It also considers the warnings it disseminates to assist in the development of alternative desirable urban futures. This paper adds to the body of Metaverse literature by extensively reviewing its theory and practice. It also examines the Metaverse's emerging products and services, and investigates potential ways it can contribute to smart cities in their virtual evolution, specifically emphasizing the sustainability outcomes related to the environment, economy, and society. This paper is structured as follows: 'Section 2' provides an overview of the Metaverse, including its origin, definitions, characteristics, alliances, and prognostications; 'Section 3' highlights the products and services offered by Meta; 'Section 3' examines the potential contributions of the Metaverse to sustainability objectives. This paper finally brings together its findings in 'Section 4' with a discussion and conclusion (Prof.Satish Kumar Kalhotra et al., 2023; Martino, 2003, Bibri, S.E., 2018, Miola & Apollonia, 2008, Dreborg, 1996, Florian Pappenberger et al., 2011, Bibri & Krogstie, 2020, Alan Thomas Roper et al., 2011).

2. Exploring the Metaverse: An Expanded Outlook

2.1. A Brief History

The concept of the 'Metaverse' was first unveiled to the global audience in 1992 through Neal Stephenson's science fiction novel titled 'Snow Crash' (Meta, 2023). In his book, Stephenson crafts a world drenched in economic failure where solace is found within the confines of a generative virtual reality environment. This narrative continues the tradition of marrying futuristic innovations with contemporary realities, a storytelling technique innovatively utilized by the likes of iconic writers like Isaac Asimov, Arthur C Clarke, Ray Bradbury, HG Wells, and Jules Verne. The 'Jetsons' series by Hanna-Barbera also notably employed this technique, captivating audiences with its imaginative features like complex robotic devices, extraterrestrials, holograms, and innovative inventions.

In his novels, Stephenson was an early prophet of concepts and devices we now identify with modern-day 'Extended Reality' (XR). He foresaw the usage of 'headsets' and 'goggles' that provide an immersive

fictional experience—an approach that set the stage for the commercial viability of these products (Milgram, 2021). XR, coined by Paul Milgram, represents an umbrella term encompassing immersive technologies like Augmented Reality (AR), Mixed Reality (MR), Virtual Reality (VR), 360 video, and beyond. Despite these groundbreaking concepts and technological explorations, the Metaverse notion faced an uphill battle for widespread consumer acceptance, even though niche sectors such as online gaming and tech enthusiasts embraced it. The virtual reality presented in Stephenson's novel did not immediately win over the general public, providing a stumbling block on the way to mass-market appeal (Meta, 2023). Nevertheless, the potential of the Metaverse, particularly in unique applications like urban planning, entertainment sectors, and the digital business world, was not entirely overlooked. These areas invoke the interests of influential entities like Meta and Microsoft, presenting promising opportunities. Today, the Metaverse concept has gradually garnered increasing attention, paving the way for potential future exploration and technological advancements in the area."

2.2. Definitions

The term 'Metaverse' has stirred considerable excitement as a forthcoming digital universe. The concept envisioned by its creators is an immersive, tangible digital world that meshes well with our day-to-day experiences and human existence (Lee et al., 2021). Facebook's CEO, Mark Zuckerberg, describes a collaborative approach to developing the Metaverse involving experts, industry participants, policymakers, institutions, and various organizations. This projected realm will be underpinned by a 3D network of virtual worlds and augmented realities, representative of a novel phase of the internet. The Metaverse is posited to be an amalgamation of physical, virtual, and augmented realities sharing an online space, illustrating people, places, and objects (Meta, 2023). This dynamic space invites humans to connect, explore, learn, work, shop, and enjoy their leisure time with others, regardless of physical proximity (Allam & Jones, 2021; Bettencourt, 2014).

Though the Metaverse concept aligns with contemporary digital progression through the 'Extended Reality' philosophy, it only garnered worldwide attention with Facebook's rebranding to 'Meta'. A Google Trends analysis from January 2008 to August 2023 highlights the sharp rise in public interest in 2023, coinciding with Facebook's rebranding announcements (Google, 2008). Before this pivotal rebranding, the Metaverse was a discrete notion confined to sci-fi narratives and specialized digital technology realms. The revitalization of interest in the Metaverse was propelled by Zuckerberg's declaration of steerage towards this new horizon. A notable surge in interest from other key technology players like Microsoft (Shaw, 2021), Apple (Adinarayan, 2021), Magic Leap (Johnson, 2012), and Roblox (Bonifacic, 2021) ensued, each unveiling their version of the Metaverse in response to what they deemed a technological niche market shift. A significant trend is that most firms exploring this potential landscape have roots in game development, demonstrating an application of the Metaverse concept in technology experimentation. Games such as 'The Sims' (2000) and 'Second Life' (2003) pioneered this concept, with present day games like Roblox and Fortnite providing players the capability to interact with the world through personalized avatars—signposting what the Metaverse might entail.

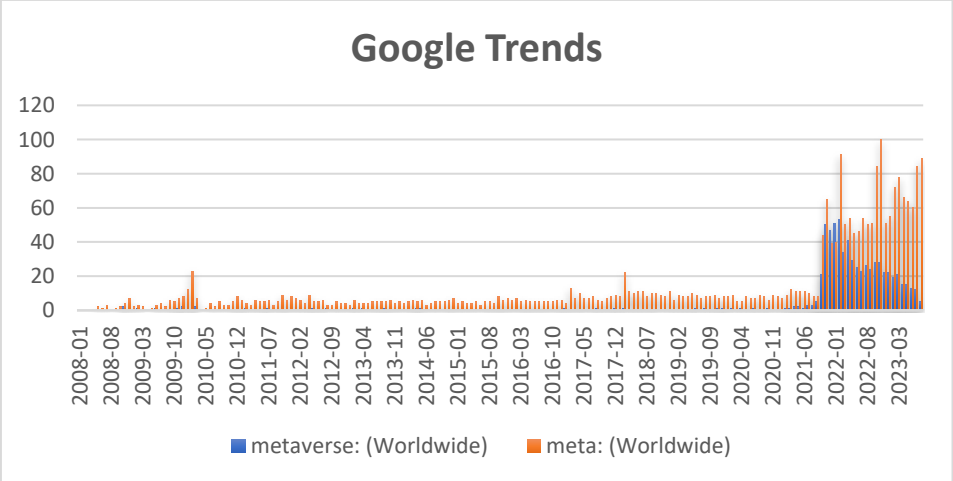

Figure 1: captures the escalating trend of the terminology 'Meta' and 'Metaverse' subsequent to Facebook's monumental rebranding and unveiling of its 'Metaverse' concept. The data for this trend was derived from Google Trends, providing a graphical representation of the rise in popularity of these terms on a global scale. The authors constructed this illustration, elucidating the snowballing

interest and discussions concerning 'Meta' and the 'Metaverse' since Facebook's significant announcement (Meta, 2021).

2.3. Characteristics

Recognizing the trend of the emerging digital realm, the Metaverse, actualizing this unique concept necessitates concerted effort, substantial resources, and wide-scale collaboration. Given the inherent complexities and novel aspects of such an undertaking, it becomes critical to engage stakeholders' collective expertise and resources across diverse sectors (Radoff, 2021). At the end of 2021, Facebook, now Meta, announced partnerships with significant entities globally. These entities span industry, governments, non-profit organizations, academic institutions, and civil rights groups, all working to actualize the Metaverse concept (Kraus et al., 2022). Some of the renowned collaborators include Colorintech in the UK, Alte Nationalgalerie in Germany, and the Peres Center for Peace and Innovation in Israel, among many others. Other key collaborators hail from institutions spread across the globe, including the Seoul National University, University of Hong Kong, the Centre for Technology, Robotics, Artificial Intelligence and the Law (TRAIL) from the National University of Singapore, and Howard University. Their role is crucial in facilitating independent external research. Further to multi-level collaboration, bridging societal and technological components emerges as a key precursor to the Metaverse's fruition (CNET, 2021). From this perspective, the focus on hardware like the VR headsets, previously targeted to online gamers, hobbyists, and enthusiasts, will need redefining. The Metaverse proposes a broader application of VR and AR technology extending beyond gaming to workplaces, social interactions, entertainment, and creative engagements (Meta, 2021b). It's thereby essential to weave these divergent uses into a cohesive research journey. The aim is to herald the evolution of these physical products into digital devices capable of drawing more individuals and groups to the digital world. With a primary focus on their advanced design and ease of accessibility, there is potential for wider acceptance and adoption of these digital tools within the community. Subsequently, big tech companies intent on actualizing the Metaverse must ensure the introduction of these physical products, such as headsets and other hardware. This approach signifies a vital first step to engaging with their target markets as it allows consumers to familiarize themselves with the gateway to the anticipated digital world (Isaac, 2021). This strategy will lay ample groundwork for fostering a seamless transition from the physical to the digital world at large.

The Metaverse, combining various sub-platforms within a unified digital framework, is poised to become the next era of computing. This innovation is speculated to intensify human reliance on distinct service experiences, independent of geographic separation. Although present users may not explicitly demand remarkable in-platform experiences, it's predicted that satisfying, enjoyable, and entertaining interactions will appeal to these users over the medium duration (World Economic Forum, 2021). In achieving these goal, Metaverse may take cues from larger tech corporations such as Apple and Google. For example, Apple has used 'keystone' stores to exhibit their products (Marriott et al., 2018). Likewise, Google and Apple offer platforms like app stores to facilitate access to diverse digital items, both their own and those from third-party developers (Isaac, 2021). Echoing these strategies, Meta, anticipating a surge in physical stores, is considering options to allow its more than 3.5 billion users to physically interact with its array of components (Dreborg, 1996). Meta's engagement with partners in product development, such as Ray-Ban, signifies another strategic move toward blending societal and technological elements. By embracing the trend toward self-promotion characteristic of 'photogenic capitalism,' Meta is subtly integrating these domains while targeting a fashionable, tech-savvy audience (World Economic Forum, 2021). A parallel strategy encapsulating this blend of the societal and technological realms is to permit the Metaverse to pragmatically emulate real-world activities like trade, work, recreation, and entertainment. Ideally, the platform will empower corporations and individuals to continue their current ventures in the Metaverse environment, mirroring their real-world engagements. As such, tools like non-fungible tokens (NFTs) become key to allowing users to hold their digital assets and products, maintaining their value and viability in both virtual and physical spaces.

The prospect of extended-reality workspaces is intimately tied to the propagation of a vibrant ecosystem, which is inherently reliant on the thriving engagement of multi-scale, third-party developers. Such developers play a pivotal role in fostering an amplified demand for a myriad of digital products, functioning as a driving force in the conception and development of diverse products catered to the ever-evolving trends and needs of communities (Lee et al., 2021). Furthermore, the active input of these third-party contributors facilitates corporations in realizing the quintessential attributes of the Metaverse, as outlined by Ball (2020). These imperatives encompass persistence, synchronicity, interoperability, economic feasibility, the quality and scope of content, the distinctness of the experience offered, and the guarantee of an interface that paves the way for boundless extensions of reality. Simultaneously, the involvement of various

entities in the construction and advancement of the Metaverse tackles the pressing concern of expansive financial requirements. These budgetary needs have been pinpointed as pivotal contributing factors in dictating the ultimate effectiveness of the Metaverse concept. The diffusion of these financial pressures might be achieved through synergistic collaborations or strategic alliances among diverse stakeholders. In encapsulation, the development and success of expanded-reality environments and the resultant Metaverse is cogently influenced by the participation of multi-scale, third-party developers. Their involvement not only helps boost the demand for digital products but also aids organizations in mastering the core attributes of the Metaverse. Lastly, the combined financial efforts of these participants alleviate the budgetary strains, often deemed as essential determinants of the viability of the Metaverse concept.

2.4. Partnerships

The involvement of differing entities is a crucial factor in constructing viable platforms and data exchanges that are pivotal to the prosperity of the Metaverse. This calls for a harmonious collaboration among diverse stakeholders to incorporate various elements, like the incorporation of 'avatars'—digital self-representations—which are projected to be of considerable importance in the virtual domain. The current generation, intertwined with technology, and their adroit language transformation into emoji-speak present an indicative preface to this impending reality. The participation of third parties in this digital revolution is instrumental, as many possess specific expertise in disparate domains, primarily in the realm of virtual gaming platforms. Amongst potential contributors are enterprises offering online gaming services wherein players can formulate their digital personas (avatars) or urban modeling interactivity platforms. In developing the Metaverse, the 'avatar' is fundamental. It embodies the objective of concocting a 'mirror world'—a virtual 3D replica of the tangible world or exploring fresh territories. Users can henceforth establish their own 'digital twin', thereby linking physical and digital realities and fostering endless possibilities (Warren, 2021). Comprehensive discourse around partnerships, interoperability, and standardization within the Metaverse framework can be accessed in the works of Bibri & Allam (2022).

2.5. Predicting the Metaverse as a Fictitious Depiction

The notion of the Metaverse is primarily a result of technological forecasting. This process involves generating a set of possible future scenarios, particularly revolving around the utilization of the internet as an infrastructure mimicking human cognition. These developed scenarios depend significantly on past data, ongoing trend analyses, and learning from these factors to predict the potential directions that internet and computing platforms might take. As Kalhotra and colleagues (2023) have indicated, this forecasting procedure extends current trends towards the future while exploring the likely technological achievements unfolding with time. The Metaverse concept stems from foreseeing how transformational advancements in technology such as AI, the IoT, Big Data, and Digital Twins might interact and impact the creation of virtual worlds in an increasingly digitizing environment. The Metaverse reflects a composite of technologies, processes, mechanisms, and systems that are integral to propelling virtual realities in a progressively digital world (Bibri, 2022). Predictions regarding when certain groundbreaking technologies or computing models will become operative, deployable, and what distinctive traits they may represent depend on a multitude of societal elements. However, these societal factors are usually beyond the scope of technology forecasters (Bibri, 2018). That notwithstanding, the predictability of technologies continues to remain elusive, irrespective of any timeframe set for expected projection. As per proponents of the Metaverse, the concept's products and services are expected to come to fruition in the approaching decade or so. Given this timely window, it's crucial to highlight and examine relevant social and environmental issues and interrogate how these advancements will be constructed and delivered. However, technology forecasting often fails to meet its objectives due to the limitations of potential significant changes. One of the primary reasons for the inaccuracies is the generation of unreliable and inaccurate data concerning location and time (Pappenberger et al., 2011). This forecasting method also tends to offer a more restricted spectrum of choices while projecting current problems into the future (Bibri & Krogstie, 2020), often neglecting or postponing the challenges of the present. Furthermore, previous forecasting studies have indicated that disregard for fields related to technological forecasting often leads to inaccurate predictions (Roper et al., 2011).

The study of urbanization and city life, as facilitated by cultural and fictional depictions, has long been a focus for academic communities (de Sá Pereira, 2019; Bassett et al., 2013; Dunn et al., 2014). These inquiries give peculiar depth to the understanding of urban growth and metamorphosis. Future research uses these invented territories as a meaningful framework for grasping complex institutional structures of plausible tomorrows (Miller, 2018). The "smart city," initially a scientifictional notion prevalent in 20th-century media, has firmly entrenched itself within contemporary urban development discourse. The potential incorporation of progressive technology is glimpsed as an all-

healing resolution to urban dilemmas. Nevertheless, the scrutiny of this utopian vision as reflected in socio-scientific studies raises eyebrows. Concerns point at how the "smart city" dream propagates techno-utopian estimations, perceived as indicative of contemporary urban future's actuation by underlying commercial interests (Bina et al., 2020). On that account, the critique of these sociotechnical dreamworlds and their fictitious portrayals as techno-utopias extends deep-seated apprehensions regarding the consequences of scientific and technological progress on society at large. To wrap up, these reviews emphasize how the promise of a technologically-advanced utopia shapes urban planning and societal structures, often downplaying the potential sociopolitical ramifications.

2.6. A Brief Overview of Relevant Studies

Metaverse research tends to bifurcate into two primary domains. The initial domain is significantly technocentric, delving into the Metaverse's facets, such as the technology it embodies, the applications it offers, potential opportunities it yields, developmental progressions it sees, trends it sets, challenges it faces, unresolved issues, planned directions, and theoretical frameworks (Taylor & Soneji, 2022; Sahraoui Dhelim et al., 2022; Kye et al., 2021; Duan et al., 2021; Mozumder et al., 2022). In contrast, the second domain revolves around studying the potential adverse after-effects of the Metaverse (Bibri & Allam, 2022; Rosenberg, 2022). The work of Bibri and Krogstie (2020) furnishes an in-depth overview of published contributions on the Metaverse, while Mystakidis (2022) offers a thorough evaluative summary of the existing literature, pinpointing the present voids or difficulties. This latter author delves into several Metaverse components, interpreted as a multi-user milieu where physical reality and digital virtuality intersect. These components include extended, virtual, augmented, and mixed reality. The further exploration gets into multi-modal Metaverse interactions, the shortcomings of 2D learning setups, a rudimentary history of virtual media and XR technologies, the role of virtual worlds and virtual reality in education, and the modern progression of the Metaverse. The detailed metanalysis allows for a richer understanding of this interdisciplinary field and can help guide future research endeavors.

2.7 Charting the Initial Metaverse: Meta's offerings

Metaverse, an ambitious concept pioneered by several tech juggernauts, has explicitly seized the attention of Meta, formerly Facebook, who is making considerable advancements by introducing potential interest areas that could transform our digital future. While Meta appears to be at the forefront of this technological revolution, other major tech players like Apple, Microsoft, and Google are also striving to sculpt their unique versions of the Metaverse, contributing to the healthy competition that will likely spur more innovative advancements. In the grand scheme of things, the diverse experiences offered by these different platforms could catalyze the development of a more intricate Metaverse. To better understand this potential, it is vital to delve into the key products that Meta has been spearheading, given that the company's strategy concentrates on subtly shaping user perceptions towards the Metaverse. This strategy provides a case study of the possible products we can anticipate in the Metaverse and could potentially illuminate the trajectory of the Metaverse evolution as illustrated in Figure 2. as various tech leaders, notably Meta, Apple, Microsoft, and Google, plunge into the race to shape the Metaverse, we anticipate a surge in innovative advancements and a broad spectrum of experiences. These particular experiences are vital, as they will cultivate our understanding of the Metaverse and further its development to create a more immersive digital reality. Thus, exploring the key products of Meta offers a preliminary view of this future landscape while tracing the path towards the realization of the Metaverse concept.

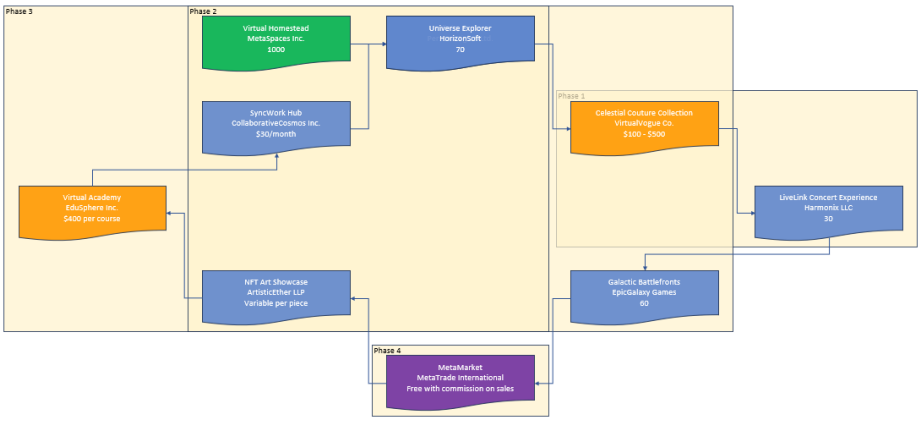

Figure 2: refers to the depiction of possible product examples one may encounter in the Metaverse, graphically represented by the authors. "Phase" in this context refers to the duration of years served.

The metaverse market is notable for its incredible diversity, with products and services spanning across various realms such as digital art, virtual fashion, online learning platforms and virtual real estate. The market comprises innovators developing rich experiences across all aspects of digital life. Interestingly, the pricing strategies across these companies are far from unified, with some implementing fixed pricing while others adopt variable pricing or subscription models. Additionally, a unique freemium model stands out, as exemplified by MetaMarket, where primary services are offered for free, and revenue is generated via sales commissions. Companies in this space have diverse lifespans, ranging from fairly new entities with just one year of service, to those with four years of tenure. This variable timeline might suggest the rapid evolution of the metaverse along with its underlying fluctuating trends. Users meticulously seeking personal expression can find solace here, as verging on all products offer an unmatched degree of customization and a personal touch. This highlights personal autonomy and expression as significant selling points in the metaverse. A unique aspect of the metaverse market is the rise in the value of digital art and Non-Fungible Tokens (NFTs) which is evident in offerings like NFT Art Showcase, a dedicated space for the purchase, trade, and appreciation of digital artwork. Moreover, a clear acknowledgment of the importance of remote work is visible in products like the SyncWork Hub, indicating the potential of the metaverse to enhance remote collaboration and interaction. The metaverse is also providing alternatives to traditional learning methods, with platforms such as Virtual Academy pioneering a new direction for education. This snapshot provides an enriching insight into the rapid development and emerging trends within the evolving metaverse market.

3. The Potential of the Metaverse for Advancing Future Intelligent Urban Centers

3.1 The Metaverse and Digital Twins

Digital Twin (DT) technology is a revolutionary approach that leverages digital representations or clones of tangible objects, processes, or services within a digital setting. The objective behind this technology is to enable the collation of pertinent data to construct advanced simulations, facilitating the examination, testing, and prediction of a respective product's, process', or service's performance in the real world [74]. The application of DT technology entails various sectors, including companies, organizations, institutions, and urban planning practices. Particularly in the field of urban planning, DT allows projection and visualization of various theoretical scenarios or 'what-if' situations, as narrated by Bibri (2021) and World Economic (2021). Consequently, this opportunity for futuristic modeling of solutions can prove tremendously beneficial for customers and user bases of these products and services. It also allows urban planners to create digital replicas of city landscapes, empowering them to evaluate capacity, assess infrastructure, and envisage real-time scenarios of urban developments or interventions.

The advantages of leveraging DT technology are manifold, including significant reductions in cost and labor associated with conventional testing and modeling techniques, which are typically time and resource-intensive. While businesses and institutions continue to explore the promising scope of DT, it is anticipated that integration with the Metaverse can further elevate its utility. The Metaverse, with its capacity for real-time updates and live data integrations, can enhance the realism of DT models, creating life-like simulations of products, processes, cities, or landscapes. This fusion of technologies would enable potential customers and community members to holistically engage with digital products or prospective urban developments, simulating their real-world experiences and enhancing user engagement. This translates to enriched human experiences, providing deeper qualitative and quantitative community engagement insights, doubling down on the refinement and enhancement of final products, processes, or urban landscapes (Theo, 2021). The integration of Metaverse and DT technology can potentially overcome existing limitations, such as storage and processing constraints, as well as issues with real-time map updating. With the Metaverse, a limitless digital repository can be established to store DTs, making them accessible round-the-clock, effectively eradicating real-time updating challenges.

The advent of Digital Twins (DT) technology in urban environments, particularly in relation to the Metaverse, holds immense potential for addressing various urban planning issues. The evolution of DT within the Metaverse's framework is poised to revolutionize the simulation and modelling of events such as floods, bushfires, traffic movements, and energy demands, especially in view of the fluctuating urban populations and climate change variables (ESRI, 2022). Crafting a DT of a city or landscape in a three-dimensional (3D) format might allow for the prediction of the potential impact of diverse concerns such as climatic shifts, traffic

dynamics, and energy production and utilization (Daniels, 2019). Notably, this next-generation adaptation of geographic information systems (GIS) enhances McHarg's concept of ecological determinism, offering a more sophisticated visual context than the capabilities of current technologies such as CommunityViz (communityviz, 2023). The employment of such predictive tools in urban planning could facilitate informed decision-making geared towards averting adverse impacts and focusing on beneficial aspects. Several urban landscapes are currently exploring the possibilities of employing DT technology, which can provide timely responses to challenges concerning urban physical infrastructures (Glickman, 2022). Exceptional instances of this application can be seen in cities such as Orlando, Las Vegas, and Boston, where virtual replicas of these cities allow local government bodies to foresee and navigate various scenarios including prospective land use and impacts of infrastructure modifications (Glickman, 2022). Potential benefits of this technology could be further amplified in the Metaverse, where urban planners, administrators, developers, and other stakeholders can interact and collaborate equally in a digital atmosphere. This would enable better planning and provide comprehensive solutions for diverse urban issues. A paramount application of DT in the Metaverse lies in managing climate change, a critical urban challenge. Through DT technology, the Metaverse could allow prediction of environment-based emergencies, such as flooding, and facilitate modeling of prospective scenarios to guide infrastructure planning and improve emergency risk response preparedness. evertheless, this concept is subjective and does not have an established presence in existing Metaverse literature. Equally vital, the Metaverse could be instrumental in lowering emissions from transportation, manufacturing, and energy generation sectors.

The Metaverse, a novel concept caught between the realities of the physical world and the boundless potentials of the digital realm, presents an opportunity for environmental sustainability through the utilization of renewable energy sources. This paradigm shift is supported by leading companies such as Meta and Microsoft, which underscore the green transition within the industry. Meta, once known as Facebook, is propelling the move towards the Metaverse while concurrently committing to total renewable energy use and net zero emissions by the year 2030 (Schroepfer & Peterson, 2020). This ambition harmonizes with the Metaverse ideology, championing a world where limitless digital possibilities are wedded with responsible energy consumption. It is also testamentary to the company's efforts to mitigate the environmental impacts associated with technological advancement. Similarly, Microsoft, another front-runner in the journey towards a Metaverse, have also set sustainability targets. The tech giant has committed to being carbon neutral by 2030 and has earmarked over USD$70 billion for the development of gaming and software integrations within the Metaverse environment (UNFCCC, 2022). Such investment indicates the company's readiness to fuse the benefits of the Metaverse with eco-friendly practices, amalgamating high-tech digital solutions with reduced environmental footprints. However, the landscape is pregnant with uncertainty. The feasibility of hitting targeted milestones is yet to be ascertained as many corporations have a history of adjusting goalposts or formulating justifications when failing to meet environmental commitments. The dynamics of setting ambitious environmental goals are often mired in shifting priorities, with financial performance often superseding ecological responsibility. Digital Twin (DT) technology could potentially bridge this gap by providing objectivity in goal setting and redesigning networks and activities to be consistent with emission reduction objectives. High emission sectors within these companies can be controlled more efficiently, contributing to the strides made towards sustainability. Furthermore, the Metaverse may facilitate a larger-scale transition to remote working, made feasible through extended reality technologies. This has environmental implications as less commuting would result in reduced carbon emissions. COVID-19 lockdowns seem to have conditioned many to work-from-home arrangements, enhancing the possibility of an enduring shift in standard practices with positive environmental outcomes.

3.2 Urban Resource Management and the Role of the Metaverse

As urban population hikes, managing natural resources such as land, water, and minerals grows increasingly critical. Understandably, city landscapes account for over 75% of the total global resource usage, significantly contributing to environmental harm through various pollution types (Environment, 2017). This scenario predicts the intensification of consumption and depletion of natural resources, driven by increased urbanization trends - tree-change, sea-change, and regionalization - without appreciating natural-based solutions capable of replacing these resources. Therefore, advances in urban resource management are required to mitigate these burgeoning challenges (Agudelo-Vera et al., 2011). In the realm of prospective solutions, the promising concept of the Metaverse, as introduced by Zuckerberg (Meta, 2021), can be viewed as a new frontier for effective urban resource management. The Metaverse has the potential to reinvent urban activities such as work, entertainment, and travel, consequently influencing

resource usage dynamics positively. The implementation of the Metaverse is expected to lessen the neccessity of commuting to workplaces, entertainment centres, and other facilities, as it engenders a digital substitute of the physical world where individuals can effectively work, learn, exercise, socialise, and more. This significant shift in patterns of human interaction towards a 'virtual' modality is already becoming apparent post-pandemic. The reluctance to return to traditional urban work environments bears testament to that. Extended reality technology, which includes Augmented reality (AR) and Alternate Universe (AU), creates a digital platform where individuals can communicate, collaborate on projects, perform telecommunication tasks, and other regular activities formerly limited to the physical world (Meta, 2021). Harnessing the Metaverse's potential could drastically cut down energy consumption tied to automobiles and reduce resource usage associated with the construction of workplace infrastructure, transit networks, and other facilities that directly support urban work environments.

The accelerated integration of advanced technologies like Digital Twins (DT) and Extended Reality (XR) alongside the rapidly cheapening and expanding internet accessibility is provoking a prominent shift from the physical to the virtual world. This progressive inclination towards the virtual realm could hint at significantly judicious resource consumption habits. More specifically, there is likely to be a broad reduction in the demand for tangible assets, including office spaces, transport infrastructure, and entertainment centers, as their digital counterparts in the Metaverse gain preference. The shift to digitally replicated environments can potentially translate into lessened material consumption and associated waste. These savings could materialize due to the decreasing allure of physical products such as office blocks and high-energy-consuming gadgets like entertainment units. Their digital equivalents in the Metaverse pose attractive, minimalistic alternatives. An immediate and compelling implication of the extensive adoption of the Metaverse is the change in the energy consumption pattern. Several research studies, including one prominent report by GlobalData Thematic Research (2021), have argued that the Metaverse might amplify the energy consumption of users, primarily due to the provision of high-resolution imagery and sophisticated rendering services, attributes that characteristically define the digital sphere. However, this conceivable rise in energy consumption might find substantial offsets in areas previously dominated by physical assets. The utilization of spaces like office blocks and entertainment centers, as well as the traffic and pollution caused by transport, could see a decrement due to the Metaverse. An equally notable counterbalance to the possible rise in energy use in the digital dominion could come from the increasing focus on renewable energy sources. Conglomerate tech companies like Microsoft and Apple have taken significant strides to transition towards renewable energy sources (GlobalData Thematic Research, 2021). Therefore, the progression towards renewable energy could balance the incremental energy consumption patterns proliferating from the Metaverse, thus playing an instrumental role in avoiding a corresponding upswing in conventional energy use through this digital transition.

3.3. Urban Governance and the Metaverse

The Metaverse harbors immense potential, particularly in its capacity to transport typically physical, resource-intensive activities such as creation of toys, games, and festive merchandise into the virtual world. Sensiba (2021) highlights the potential of such digital transformation to reduce resource consumption and pollution. Conventionally, once used, many of these products find their destination in landfills, water bodies, or other sensitive ecosystems, exacerbating environmental degradation and impacting diverse contexts such as urban, marine, and biodiverse environments. With a significant volume of material possessions transitioning into their digital counterparts, the strain on the physical resources can relent. This can provide cities room to bolster their environmental assets – green spaces, water bodies, cultural heritage sites, and more - perking up the cities' sustainability quotient. A digital turn also unveils opportunities to leverage nature-based solutions to rehabilitate areas previously affected by rampant consumption. Urban governance – the blend of multitudinous approaches by individuals, institutions, and stakeholders in planning and managing city affairs – is often clouded with complexities and controversies (Thrift & Kitchin, 2009, pp. 622–627). These surround the exercise of authority, the distribution and allocation of resources, and the enactment of disparate agendas. This raises a crucial need for unity and collaboration to meet city objectives, and evolving urban challenges are addressed holistically with financial sagacity. This aligns seamlessly with the ethos behind the United Nations' 17 Sustainable Development Goals (SDGs) (United Nations, 2022). Furthermore, the urban governance framework recognizes Information and Communication Technology (ICT) 's crucial role. In its potential to safeguard the environment, amplify resource efficiency, modernize legacy infrastructure, catalyze socio-economic development, and expand human knowledge, ICT establishes itself as a valuable ally in advancing a city's sustainability strategy (Allam, 2020).

At its core, urban governance stands for human-centric decision-making processes aimed at aligning

the various aspects of the urban ecosystem towards sustainable harmonization. The Metaverse introduces an exciting platform that could revolutionize urban governance in the multifaceted urban landscape. The Metaverse can present urban services and assets in a virtual format, paving the way for their enhanced efficiency. It could potentially engineer a new avenue of trust and accountability while mitigating the bureaucratic hindrances and bottlenecks that often slow down urban service delivery. Given its capacity to reduce costs and time-consumption, the Metaverse could be instrumental in expediting and improving urban service distribution. This futuristic concept finds practical application in Seoul, South Korea. The city plans to incorporate the Metaverse into its urban governance model by offering some public services and cultural products in a digital environment (Squires, 2021). By harnessing the power of Virtual Reality (VR) headsets and Augmented Reality (AR) glasses, Seoul's citizens can have an immersive experience of their city. These technological innovations breathe life into virtual entities like social halls, museums, and parks. They also simplify access to government services such as lodging civil complaints (Gaubert, 2021). Thus, the Metaverse has the potential to reshape the urban governance landscape by facilitating the virtual availability of services and assets. This, in turn, could streamline service delivery and elevate the urban experience, paving the way for sustainable and efficient urban governance.

The Metaverse, an emergent concept blending digital and physical reality, is poised to provide governments with an array of future opportunities for inventive problem-solving. This is particularly evident in the face of urban challenges such as healthcare delivery, urban planning, and the effective utilization of urban spaces. According to Sudan (2021), the feasibility of telehealth, virtual development proposal modeling, and virtual engagement in social and music events underscore the potential utility of the Metaverse in revitalizing city landscapes. Beyond pure recreation, the Metaverse is projected to open new avenues for employment, establish innovative educational platforms, and stimulate diverse socio-economic activity areas. Governments are likely to manage key activities, such as identity verification and personal registration through virtual channels, thus eliminating the necessity of physical presence. Meta (2021) predicts that the Metaverse will add an authentic and intrinsic 'realness' to these processes. However, the transition into a Metaverse-centric urban governance system requires substantial inputs, both financially and time-wise. The concept affiliates itself quite seamlessly with the futuristic world illustrated by Hanna-Barbera's The Jetsons, signifying an advanced societal framework. Acknowledging the expansive benefits available, it becomes a worthwhile endeavor for local governments to support and explore the Metaverse concept.

Interestingly, the ongoing evolution of the Metaverse presents an immediate opportunity for governments to utilize technologies like Augmented Reality (AR) and Blockchain to ease city-based inequalities. Entropy aside, the Metaverse holds abundant promise towards improving interactions between local governments and residents. It serves as a catalyst for achieving efficient, real-time service delivery, and the enhanced management of resources such as urban spaces. Innovatively, it also introduces new potential streams of income, facilitating local governments in undertaking complex, capital-intensive projects. It prompts a reconceptualization of traditional urban planning models towards designs that are more accommodating of human and social dimensions. In the broader domain, institutions including businesses, educational entities, and large corporations stand to leverage the Metaverse to optimize their operational activities. The virtual universe cultivates an interactive environment to enhance client relationships and improve product quality. Emerging technologies, such as Digital Twin (DT), are set to be leveraged significantly, improving the interaction within the Metaverse. Furthermore, these entities are likely to explore novel horizons, such as the creation of virtual products to augment avatars. As the Metaverse unfolds, these virtual goods may emerge as future commodities in high demand. Overall, the Metaverse, while still evolving, promises to redefine urban governance, heralding a new chapter in the delivery of urban services and management.

Concerns are expressed over the ability of the Metaverse to tackle conventional urban governance challenges such as continuous negotiations and disagreements, diverse interests and incentives, unpredictable decisions, inefficient collaborations, and ineffective networks. Traditionally, introducing innovative technologies for human collaboration has steered more towards political and economic goals rather than transparent governance processes. There is criticism towards smart city governance for being heavily influenced by government policies and the vested interests of high-tech companies. This leads to a technocratic, corporate-driven approach to governance that potentially risks negative implications, which has captivated the academic attention for studies (Bibri, 2021b). Therefore, it is imperative to involve governance structures at city and national levels to ensure the original purpose for adopting the Metaverse is not subverted for other interests (Bibri & Allam, 2022). Similar to smart cities, enhancing governance would necessitate the involvement of all stakeholders, emphasizing a shift from top-down decision-making structures to bottom-up approaches, wherever possible. Such a collective approach promises more comprehensive and inclusive solutions.

3.4. The Metaverse and Its Impact on Living Standards

Urban quality of life hinges on a multitude of factors such as transportation and mobility facilities, housing options, health and sanitation services, recreational activities, infrastructure provisions, economic opportunities, educational facilities, and beyond. As Luger (1996) described, the diversity and abundance of these components influence individuals' perception of their life quality, and the degree of satisfaction depends on their priorities. Nevertheless, community well-being goes beyond individual perceptions. It is argued that basic elements such as socioeconomic contexts, environmental sustainability, improved governance, and cultural diversity are crucial to ensure continuous growth in urban quality of life (Pazhuhan et al., 2020). Considering the worldwide diversity, the states of these elements vary among cities, leading to different experiences in the quality of life. Moreover, with emerging challenges such as ecological degradation, climate change, pandemics, economic struggles, and insecurity, urban livability has experienced significant fluctuations. Many cities have witnessed a decline in quality of life due to these challenges with a considerable amount of resources allocated to mitigate these issues (VR, 2021; Pickavet, 2021). Consequently, the global community unanimously enacted Sustainable Development Goal (SDG) 11 to tackle urban issues and enhance inclusivity and livability.

Technology's role in promoting the quality of life within urban settings - spanning across urban planning, transportation, energy production, health care, education, and entertainment - has proven instrumental in tackling numerous contemporary urban challenges. However, while technology carries significant potential, it isn’t the sole panacea due to the persistent issue of funding. With the advent of the Metaverse, a significant portion of these urban struggles could potentially see substantial mitigation, resulting in a substantial enhancement in the quality of life for urban dwellers. The Metaverse presents a remarkable prospect in rendering numerous services in the virtual space, including sectors such as entertainment, education, civil services, and virtual work environments. This development is likely to promote increased accessibility and fairness, alleviating the physical and resources constraints commonly associated with such services. Proposed benefits may include reduction of time and resources typically exerted in commuting, renting, and accessing these services. With the promise of service ubiquity, amplified social interactions, and the provision of expansive informational resources and opportunities, individuals could invest their resources in areas that foster personal growth, maintain health, and promote social development. In turn, such advancements could substantially bolster urban livability.

Nevertheless, it's important to note that the Metaverse does not offer comprehensive solutions to narrow economic disparities. As a result, there lies a need for local government bodies to seek alternative methods in order to minimize such economic divides. A less-discussed aspect is the technology accessibility division and discrimination currently transpiring, with the primary drivers of technology adoption being tech-savvy individuals. This dynamic opposes the ideal of universal accessibility, excluding sections of society that are not tech-savvy, people from pre-laptop generations, and those living with disabilities. This scenario underscores a crucial need for escalation of inclusivity at all layers to ensure that the vast majority of urban residents, if not all, are equipped to benefit from services transitioning to the virtual sphere. Without this fundamental inclusivity, there is a risk of the Metaverse exacerbating the existing inequality gap in urban areas, a problem already deeply
entrenched in most cities.

3.5. Social Engagement in Urban Spaces Within the Metaverse

Urban spaces are characterized by their vibrant blending of diverse cultures, underlining the crucial aspect of human social interaction. Yet, it's important to note that social engagements in cities can be elusive due to various factors such as economic disparities, politics, capitalism, and socio-economic inequalities (Liang et al., 2021). While cities symbolize cultural diversity, ironically, individuals often find little time to engage and reflect on this richness. Adding to the complexity is our traditional city planning approach, endorsing elements such as individualism evident in preferences like private car ownership and the selection of car types, building high-rise structures devoid of mixed-use designs, and minimizing public recreational spaces (Jacobs, 1961). The increasing trend of automating urban elements also dwindles social interaction opportunities, with most advantages leaning towards those better off economically and more educated.

New urban development models like the '15-Minute City' (Bettencourt, 2014; ESRI, 2022) and the 'Data-Driven Smart Sustainable City' (Bibri, 2021b) are progressively gaining traction. These models highlight the importance of reducing automobile dependency and fostering community interaction within neighborhood confines through walking, biking, and spending time at local entertainment centers (Moreno et al., 2021). With society's inherent social nature as famously referenced by Aristotle, terming humans as 'social animals'

(Kietzmann, 2019), it's evident that individuals manage to engage socially amidst various urban obstacles. Here, social media platforms have filled a critical void. However, their scope is limited in bridging the gap for closer human connection. In this context, the upcoming Metaverse concept, a synergistic fusion of the physical and virtual worlds, appears promising in overcoming social interaction challenges faced by urban inhabitants. The futuristic vision of the Metaverse is anticipated to redefine social experiences through extended reality technologies. As Zuckerberg (as cited in Cassauwers, 2019) outlined, the Metaverse will allow individuals to interact, participate in events, explore new realms, and experience everything together in a virtual setup mimicking the real-world environment. Moreover, the mooted Metaverse could potentially break down notable social hurdles like spatial distance and racial segregation, among others, that obstruct physical social interactions. The facility of representing oneself as an avatar in the virtual environment (Duan et al., 2021) is expected to create a more inclusive and engaging social sphere, thereby enhancing urban social experiences significantly.

In today's age, where digital interactions are swiftly replacing traditional social interactions, a plethora of ethical and moral concerns are surfacing. Cyber threats, sexual predators, terrorism entrapment, indoctrination, and invasions of privacy and security are rapidly emerging in the virtual world (Hackl, 2020). While large tech firms striving to create the Metaverse—a completely immersive virtual reality—acknowledge these potential pitfalls, these issues could potentially hinder individuals from fully engaging with and exploiting the Metaverse. Moreover, the cost barrier for essential hardware and technologies such as headsets stands as a significant challenge. The economically disadvantaged sectors of society may find themselves unable to partake in the virtual experience due to financial constraints, thereby perpetuating the pervasive disparities in today's society (Lee et al., 2021). Furthermore, the Metaverse may not accommodate individuals with unique physical challenges, particularly those who are visually or audibly impaired. While technologies may provide relief for some, the visually impaired might be significantly excluded unless advanced technologies are developed to address their needs. However, the Metaverse concept's utmost realization may give rise to a cyber-dystopia, marked by societal disruption on unprecedented levels. As conceptualized by Nye (2007), cyber-dystopia describes a society worsened due to unfettered technological advancements resulting in an over-reliance and loss of control. The Metaverse, in its intrusive and invasive nature, might dangerously trespass upon individuals' privacy rights. It can evoke worldwide anarchic scenarios due to non-adherence to the systems and regulations safeguarding users' dignity and self-worth. This invasive digital world's repercussions could cause detrimental shifts in social interactions with new media pushing individuals away from their intimate relationships. This shift might lead to the substitution of face-to-face interaction with mediated relationships or increasing dependency on media for engagement (Baym, 2015). Thus, while the Metaverse holds exciting potential for technological advancement and immersive experiences, it could instigate significant societal transformation that could potentially cause more harm than good.

Technological dystopia, according to Rushkoff (2002), revolves around the unintentional, and often unforeseen, adverse implications induced by novel technologies, amplifying humanity's worst facets. Nevertheless, the COVID-19 pandemic has brought forth a situation arguably more severe. Instigating worldwide lockdowns, the pandemic threatened to press pause on numerous activities globally, particularly within urban zones. Yet, technology emerged as a critical linchpin in sustaining various operations in different sectors during this crisis. Due to the adaptability and resourcefulness offered by digital solutions, activities in multiple facets of life were allowed to continue seamlessly—albeit on virtual platforms—mitigating potential major stoppages. In this sense, Sensiba (2021) suggests that notwithstanding any dystopian drawbacks of new technology, the recent health crisis has illuminated its capacity to serve as a proactive pillar supporting societal functions during unprecedented circumstances. Therefore, while technological advancements can sometimes exacerbate certain negative aspects of human behavior and societal interactions—thus giving rise to the notion of a technological dystopia—their contribution during the global turmoil caused by the COVID-19 pandemic reaffirms their critical importance in maintaining societal continuity and resilience in the face of adversity.

3.6. Urban Tourism and the Metaverse

Urban areas worldwide are distinguished by unique attributes that make them fundamental parts of global tourism. Some of these characteristics are defined by cultural value exemplified through World Heritage sites, as recognized by UNESCO (Centre, 2016). Many of these urban spaces, such as Jerusalem, Hội An (Vietnam), Bruges (Belgium), Fez (Morocco), and Bath (UK), are privileged to be listed as World Heritage sites in their own right (Centre, 2023). Tourist attractions are not exclusively about historical or cultural heritage. Complementing these urban reservoirs of human history are aesthetic elements—museums, monuments, amusement parks, and more—dotting

the global urban landscapes. All these tangible elements of our collective human journey, together with the less tangible heritage like local traditions and customs, make these cities culturally vibrant. Thereby, turning them into irresistible destinations for tourists seeking unique experiences (Petronela, 2016; Masoud et al., 2019). But urban tourism also grapples with numerous internal and external challenges. Problems like pollution, traffic congestions, security concerns, seasonal imbalances, competition from emerging touristic trends are some of the continual hurdles it faces (Squires, 2021; Gaubert, 2021; Sudan, 2021). Financial challenges further muddy the waters, complicating branding endeavors, conservation efforts, and the creation of fresh touristic products and experiences (Hervé, 2017; Information Resources Management Association, 2017, pp. 1258–1279). However, the rising concept of Metaverse offers anticipatory solutions to many of these challenges beleaguering urban tourism. Through the Metaverse, the physical and digital worlds can intertwine, creating a 'phygital' environment where multiple tourist attraction sites can be experienced in both real and virtual forms (Chapman, 2021). The Lume in Melbourne, Australia, a place for engaging with art, provides an illuminating example of such a blend of physical and virtual realms (Melbourne, 2023).

The benefits of this phygital approach are multifold. People, irrespective of their geographical location or physical constraints, would have the chance to virtually visit and experience various attraction sites and interact with their digital twins. It will enable them to explore vast terrains and product ranges without needing to travel physically. Although on the surface, the Metaverse's emergence may seem to endanger the physical travel industry, it would far from spell its demise. Our sensory experiences and emotional connections to real-life activities—like mountain climbing or a visit to the beach—cannot be completely replaced by virtual recreations. Hence, while the Metaverse can enhance and diversify our touristic experiences, it can never fully replace the allure and charm of physical travel. As a transformative technological tool, the Metaverse is poised to significantly redefine experiential travel and heritage conservation (xrtoday, 2021). Rather than curtailing physical travels, it is expected to stimulate interest among travelers to explore different locales in person by facilitating immersive experiences virtually in real-time. This will enrich the travel experience and allow businesses to present their offerings through virtual advertisements, enabling prospective patrons to familiarize themselves with their expectations. The Metaverse's potential extends beyond promoting tourism to preserving fast-vanishing heritage and cultural sites threatened by urbanization, terrorism, climate change, and natural disasters among other perils. Unlike their physical counterparts, digital assets within the Metaverse are less susceptible to tampering or outright destruction. This paradigm shift is particularly significant for urban heritage sites for which the twin benefits of enhanced appeal and conservation can be actualized simultaneously. Moreover, the Metaverse's success could bring about positive socio-economic impacts. These include augmenting financial resources funneled into the maintenance of physical sites, stimulating job creation in tourism-related sectors and adjacent industries such as hospitality, and fostering inventions of novel tourist products and services. An exemplification of this trend can be seen in Santa Monica, California, where a metaverse social app enhances user exploration of the city while simultaneously promoting local businesses, bolstering the city's revenue. Meanwhile, applying innovative tools like blockchain technology and non-fungible tokens (NFTs) in the Metaverse can further preserve historical sites. Transactions involving these sites can be accomplished via digital currency, which not only appeals to digital enthusiasts but also prevents the devaluation of these precious sites. These developments unlock the opportunity of global access to cultural heritage while presenting an advanced platform that merges travel, conservation, and economic stimulation. The Metaverse heralds a new dawn in experiential travel and heritage site conservation. By coupling enhanced user experience with preservation and economic benefits, it not only safeguards the tapestry of human history but also gilds the travel industry with technological allure.

3.7. Adapting and Mitigating Urban Climate Change through the Metaverse

Urban areas around the world have experienced escalating threats from climate change, amplified by recent changes due to the pandemic (Allam et al., 2020). Elements like heatwaves, flooding, and unpredictable weather patterns present pervasive issues. The dilemmas posed by climate change are universal, with all metropolitan regions at risk, subjected to several fluctuating factors (Allam & Jones, 2019).

Cities have been the crucible of climate change resilience and mitigation initiatives. While doing so, these urban areas also grapple with challenges of burgeoning population and climbing resource consumption, notably energy, which largely stems from non-renewable sources. Moreover, cities house approximately two-thirds of global vehicles, contributing about 20% to global emissions (Wiggins, 2020). So profound is the footprint of urban areas that they are responsible for nearly 75% of global greenhouse gas emissions, given their centrality to economic activities (unhabitat, 2021). Despite concerted global efforts to confront climate

change, as manifested in agreements such as the 2015 Paris Agreement, the Sustainable Development Goals (SDGs) of the United Nations General Assembly in 2015, and the 2017 New Urban Agenda (NUA)–Habitat III, the task remains daunting. This was confirmed in the Intergovernmental Panel on Climate Change (IPCC) report, warning about an anticipated rise in global temperatures to 2°C above pre-industrial levels. The targets set in the Paris Agreement aim to limit warming below 2°C, attempting to restrict it to 1.5°C pre-industrial levels (Global Warming of 1.5°c an IPCC Special Report, 2019). The relentless onslaught of climate change coupled with burgeoning urbanization points towards a complex dynamic, challenging the limits of traditional resilience and adaptation solutions. Despite significant strides made on an international scale through various accords and policies, there is still an urgent need for effective interventions. Innovative approaches like the Metaverse could factor into this equation, giving a new dimension to climate change mitigation and adaptation efforts in urban settings.

As the world continues to confront climate change, the focus on decarbonization is becoming paramount, as embodied in the 2021 United Nations Climate Change Conference (COP26). However, the novel concept of a Metaverse, a virtual-reality space where users can interact with a computer-generated environment and other users, could have significant consequences for decarbonization and achieving additional global climate goals. One significant environmental benefit of the Metaverse is its potential to reduce the frequency of human travel and commuting. As the transition to a digital workspace gains momentum, employees can inhabit the Metaverse as a replica of their physical workplaces, operating virtually from the comfort of their homes. This shift eliminates physical commute, thereby reducing vehicular emissions and contributing to decarbonization. The Metaverse also provides possibilities for minimizing resource consumption. With the advanced digitalization, it can host virtual representations of entities, ranging from toys to recreation and entertainment products. By replacing physical objects, which often result in waste when they become outdated or stop being useful to users, we reduce energy use and material waste, leading to a concurrent decrease in global emissions heavily influenced by manufacturing and consumption. Climate change also poses significant challenges to urban adaptation – particularly in tourism-centric cities. Many of these locations have witnessed firsthand the impacts of climate change in terms of flooding (Germany), rising sea levels (Venice), tsunami devastation (Tonga, Japan), and other factors leading to siltation (Bhola-Paul, 2015). These climate-induced changes hamper traditional economic activities, forcing urban residents to seek alternative livelihood options or to migrate due to disruptions to their income streams (Baym, 2015; Rushkoff, 2002). Nevertheless, the Metaverse also usher in a new era of digital opportunities. As traditional economic frontiers shrink, the rise of the Metaverse could offer underemployed urban inhabitants the chance to transition into exciting digital roles including, creators, performers, builders, gamers, and more (Radoff, 2021a). The Metaverse is not just a tool for escapism or entertainment. It is also potentially a powerful component in the fight against climate change and tool for socio-economic resilience in the face of an evolving global climate.

The Metaverse - a virtual reality space that allows users to interact digitally with a computer-simulated environment - extends beyond just a tool for remote communication or an entertainment platform. It holds the potential to serve as a crucial tool in disaster management and climate change mitigation. One significant way the Metaverse can contribute to this field is by developing sophisticated early-warning systems for disaster management. Intuitive and integrated digital platforms can effectively mitigate potential damage, by protecting infrastructure and, importantly, human lives. Even though the feasibility of implementing such advanced systems remains a topic of ongoing discussion, the Metaverse's potential to develop simulations and map scenarios could revolutionise the planning and design of climate change mitigation tools. An important application of these digital simulations lies in eco-cities, which are often confronted with challenges associated with sustaining resilience in the face of climate change as urbanization continues to progress (Bibri, 2021d). The growing importance of these digital interventions aligns with the needs of these eco-cities, helping them understand and predict potential environmental challenges and devise effective mitigation strategies. Nature-Based Solutions (NBS) are key to enhancing the resilience of an urban fabric in the face of climate change. Successful integration of NBS into cityscapes, such as the addition of vegetated walls and roofs in various infrastructures, increasing green cover, and restoring wetlands, have demonstrated promising potential in mitigating climate change impacts while delivering co-benefits to inhabitants. These urban green infrastructures provide multiple ecosystem services, including air purification, micro-climate regulation, recreational opportunities, and water management, all of which contribute significantly to bolstering urban resilience in the face of environmental challenges. The Metaverse could serve as an extraordinary tool for building resilience against climate change through disaster management, scenario mapping, and even enabling smarter integration of NBS in cities, marking an important step towards a more sustainable future.

3.8. Urban Structure and the Role of the Metaverse

The Metaverse - a virtual reality space that allows users to interact digitally with a computer-simulated environment - extends beyond just a tool for remote communication or an entertainment platform. It holds the potential to serve as a crucial tool in disaster management and climate change mitigation. One significant way the Metaverse can contribute to this field is by developing sophisticated early-warning systems for disaster management. Intuitive and integrated digital platforms can effectively mitigate potential damage, by protecting infrastructure and, importantly, human lives. Even though the feasibility of implementing such advanced systems remains a topic of ongoing discussion, the Metaverse's potential to develop simulations and map scenarios could revolutionise the planning and design of climate change mitigation tools. An important application of these digital simulations lies in eco-cities, which are often confronted with challenges associated with sustaining resilience in the face of climate change as urbanization continues to progress (Bibri, 2021d). The growing importance of these digital interventions aligns with the needs of these eco-cities, helping them understand and predict potential environmental challenges and devise effective mitigation strategies. Nature-Based Solutions (NBS) are key to enhancing the resilience of an urban fabric in the face of climate change. Successful integration of NBS into cityscapes, such as the addition of vegetated walls and roofs in various infrastructures, increasing green cover, and restoring wetlands, have demonstrated promising potential in mitigating climate change impacts while delivering co-benefits to inhabitants. These urban green infrastructures provide multiple ecosystem services, including air purification, micro-climate regulation, recreational opportunities, and water management, all of which contribute significantly to bolstering urban resilience in the face of environmental challenges. The Metaverse could serve as an extraordinary tool for building resilience against climate change through disaster management, scenario mapping, and even enabling smarter integration of NBS in cities, marking an important step towards a more sustainable future.

As the myriad of options for inhabitants of urban regions proliferate, a potentially unexpected shift in demographic trajectories may await us. This notion proposes that urban centers may not experience a swelling in population as previously projected (Smith et al., 2012). An implication of this change is that towering, densely-packed office complexes may be rendered obsolete as the need to streamline significant workforces into a singular geographical space decreases. Assuming that the urban population growth curve does indeed flatten, drastic changes in the infrastructure and form of cities might be on the horizon. A critical driver of urban planning for the past several decades has been population density and the subsequent need for travel. Should this paradigm be altered, planners and policymakers will need to adapt to and design for a different set of considerations (Johnson & Thompson, 2015). However, it's prudent to remember that while the Metaverse remains in its nascent stages (Hervé, 2017), cities will likely retain their allure for diverse individuals seeking myriad opportunities. Despite the further advancements in the Metaverse, urban environments, boasting considerable infrastructure, will continue to magnetize masses. The tectonic shift in the relationship between work and urban dwelling hubs may encourage alternative city planning models. One potential model that might gain traction is the '15-minute city' paradigm (Marriott et al., 2018), wherein all essential services are accessible within a 15-minute travel radius of residences. As we continue our foray into the digital era, the Metaverse's hyper-connectivity is expected to further galvanize the appeal of urban centers. Beyond convenience and opportunity, the steep uptick in digital transactions will likely herald increased revenue flow for these areas, further incentivizing urban migration (Liu & Grusky, 2013). As we stand on the precipice of a digitally-powered future, the face of urban growth as we know it may undergo significant reformation.

The 'data-driven smart eco-city' concept represents a transformative approach to urban planning and sustainability (Bibri, 2021d). Many of its fundamental tenets rely heavily on natural elements that have been repeatedly linked to powerful positive effects and enhanced psychological states. These influences extend to the immediate presence of nature and are tied to observable results such as stress reduction (Parsons et al., 1998), exceptional or 'peak' experiences (Inghilleri et al., 2015), restored attention spans (Tennessen & Cimprich, 1995), and augmented positive emotions (Richardson et al., 2016). Interestingly, these influences aren’t solely confined to physical natural environments. Studies show that even virtual representations of natural environments, as experienced through technologies like Virtual Reality (VR), stimulate similar positive outcomes (Allam & Jones, 2019; Wiggins, 2020; unhabitat, 2021). In the light of a changing global climate (IPCC, 2019), VR poses a transformative tool that can simulate natural conditions impacting emotional states, offering substantial socio-psychological benefits within urban contexts. Virtual Reality, and its immersive capacity, finds its niches in the projected evolution of urban spaces, especially within the framework of the Metaverse. The immersive properties of VR could hypothetically enhance the restorative effects of simulated natural environments, making it an

invaluable asset in future urban design (Felnhofer et al., 2015).

Furthermore, these 'transformative simulations' offer enormous potential for actively involving citizens in shaping their own environment. By introducing e-participation, VR allows users to visualize proposed designs, consider alternatives, or directly engage with and modify 3D model components (Alcaide Muñoz, 2019). This interactive facet allows for robust collaboration, engaging citizens in an inclusive design process and providing a dynamic platform for exploring prospective interactions with their future environment. Therefore, the 'data-driven smart eco-city' thesis demonstrates extensive potential for capitalizing on the versatile capabilities of VR. By stimulating positive psychological responses and nurturing progressive urban development through

dynamic design processes, these transformative technologies could become integral in the pursuit of smarter, greener urban environments. Shaping future cities, the convergence of emerging technologies and natural elements will likely bring about sustainable environments catering to biophilic needs while building resilient communities.

4. Discussion and Conclusions

The Metaverse, a concept that has recently gained considerable attention, particularly with Facebook's transformation into Meta, presents itself during a period of global challenges necessitating immediate resolutions. These challenges include climate change, rapid population growth, unchecked urbanization, and the ongoing COVID-19 pandemic. These issues substantially impact various facets of our global environment, and their consequences could intensify before the current century concludes (GCA-Events, 2023). Climate change, a topic prominently addressed at the COP26 meeting, continues to affect numerous aspects of our global environment. On the other hand, rapid population growth and uncontrolled urbanization aggravate this situation further. These factors contribute to other problems such as resource depletion, socio-economic disparities, and other urban issues (Allam et al., 2021). The COVID-19 pandemic has also significantly disrupted global systems, notwithstanding the considerable strides made in economic growth and social development (The World Bank, 2020; Dijck et al., 2018; Parsons et al., 1998). Intriguingly, the rise of these challenges coincides with the advent of groundbreaking technologies. These technologies, in theory, should have mitigated the widespread impacts of climate change that we are currently witnessing. The Metaverse, as a concept, and its incorporation into urban settings is one such technology. Its potential benefits and challenges are detailed in Table 1.

Urban Sectors/Technologies	Contributions	Challenges
Urban Planning and Development	1. Interactive Planning: Metaverse tools can provide a more immersive and interactive planning experience, allowing planners to visualize and manipulate urban designs in real-time. 2. Simulation and Anticipation: Metaverse can simulate urban growth patterns and anticipate the impact of development decisions, leading to more informed and effective planning. 3. Stakeholder Engagement: The Metaverse can provide platforms for stakeholders to explore and provide feedback on potential urban development scenarios.	1. Skill Gap: Urban planners may lack the technical expertise required to effectively use Metaverse tools. 2. Disconnect from Reality: There's a risk that the Metaverse simulations might not accurately represent the complexities of real-world urban environments. 3. Accessibility: Not all stakeholders may have access to the required technologies, leading to potential exclusions.
Transportation	1. Traffic Simulation: The Metaverse can provide detailed simulations of traffic scenarios, helping planners plan and improve transportation infrastructure more effectively. 2. Virtual Experiences: The Metaverse can offer virtual transportation experiences, such as virtual tours of public transit facilities or virtual test drives of new routes and transportation modes.	1. Technical Limitations: The Metaverse's ability to accurately simulate real-world transportation scenarios is still developing. 2. Infrastructure Limitations: Existing infrastructural limitations may hinder the implementation of Metaverse solutions.

		3. Over-reliance on Digital Solutions: There's a risk that over-reliance on digital solutions might lead to negligence of physical infrastructure.
Education	1. Immersive Learning: The Metaverse can provide immersive, experiential learning environments that engage students in new ways. 2. Distance Learning: The Metaverse can enable more effective distance learning, allowing students from different locations to learn together in a shared virtual environment.	1. Accessibility and Equity Issues: Students with limited access to technology may be left behind. 2. Social Interaction: Virtual environments might not provide the same level of social interaction as traditional classrooms. 3. Educational Quality: The efficacy of Metaverse-based learning compared to traditional methods is not fully understood.
Healthcare	1. Virtual Consultations and Telemedicine: The Metaverse can provide platforms for virtual medical consultations and telemedicine services, increasing the accessibility of healthcare services. 2. Medical Training: The Metaverse can simulate medical procedures for training purposes, providing healthcare professionals with risk-free learning experiences.	1. Patient Privacy and Data Security: There are significant concerns about the protection of patient data in a Metaverse environment. 2. Accessibility and Equity Issues: Not all patients may have access to the necessary technology to use Metaverse services. 3. Regulatory Challenges: There may be legal and regulatory hurdles to the widespread adoption of Metaverse technologies in healthcare.
Public Services	1. Citizen Engagement: The Metaverse can provide platforms for enhanced citizen engagement, including virtual town hall meetings and public consultations. 2. Service Delivery: The Metaverse can provide virtual platforms for delivering public services, potentially increasing accessibility and efficiency.	1. Digital Literacy: Not all citizens may have the digital literacy required to engage with public services through the Metaverse. 2. Access Disparities: There may be disparities in access to Metaverse technologies, leading to inequitable service provision. 3. Data Privacy and Security: Public services through the Metaverse would involve handling sensitive data, raising concerns about data privacy and security.
Commerce	1. Virtual Stores: The Metaverse offers opportunities for businesses to open virtual stores, potentially reaching a wider audience and providing immersive shopping experiences. 2. New Business Models: The Metaverse can enable new business models, such as virtual real estate and digital goods.	1. Increased Consumerism: The Metaverse may encourage increased consumerism, leading to potential negative societal and environmental impacts. 2. Technical Barriers: Businesses may face technical barriers when trying to establish a presence in the Metaverse.

		Economic Barriers: There may be economic barriers to entry for smaller businesses, potentially leading to increased economic inequality.

Table 1 displays the authors' analysis of the potential benefits and obstacles of incorporating the Metaverse into urban environments.

The challenges outlined previously have significantly impacted individuals, particularly those living in urban areas. They often lack the time or means to engage in basic human activities such as socializing, self-fulfillment, or accessing healthcare and education services. Furthermore, they often lack the leisure time for amusement, creativity, and innovation (H, 2020). These complications have exacerbated issues such as unemployment, cultural erosion, cultural heritage deterioration, and other problems directly affecting human life. Nonetheless, the anticipated Metaverse is predicted to provide solutions to some of these difficulties. The Metaverse promises to provide unmatched opportunities for social engagement with friends and family members, regardless of geographical distance (CNET, 2021). It also enables people to work and collaborate with colleagues and peers without the need to commute to physical workplaces (Meta, 2021). Moreover, the Metaverse can help address the problem of cultural disintegration by offering extensive opportunities for individuals to preserve, showcase and pursue their tangible and intangible cultural heritage in ways that the physical world doesn't permit. As mentioned earlier, the merging of physical and virtual realities can play a pivotal role in tackling problems like climate change. The necessity for resource utilization to manufacture certain goods could be mitigated, as these goods could be stored as virtual products. Unlimited individuals could share these virtual products without diminishing their quality or quantity. The Metaverse could also induce changes in urban morphology. Planning models would no longer be influenced by factors such as vehicular traffic. Instead, the successful implementation of the Metaverse could hasten the realization of urban planning concepts like the 15-minute city, which emphasizes human and social dimensions (Bettencourt, 2014; CommunityViz, 2023). These concepts prioritize human and social aspects,

offering a more holistic approach to city planning and living. The Metaverse holds significant potential for resolving many of the challenges faced in urban settings, from social interaction to cultural preservation and resource conservation to urban planning. The Metaverse promises a future where urban dwellers can thrive in a more balanced, sustainable, and culturally rich environment by providing a space where physical and virtual realities can coexist.

The metaverse, a virtual environment that promises many opportunities, has yet to reach its full potential due to technological constraints. This futuristic concept relies heavily on advanced technologies, software, and hardware, which are currently inadequate for the immersive experience it envisages (CNET, 2021). The development and realization of the metaverse require substantial resources, time, expertise, collaboration, and innovation to integrate various elements and ideas. Consequently, the proponents have urged for patience, acknowledging the enormity of the task ahead. Financing is a crucial element in the development of the metaverse, particularly due to the extensive resource mobilization necessary for the prerequisite hardware and software. This financial aspect becomes even more critical when parallel technological concepts, such as the smart cities planning model, are taken into account (Allam et al., 2021). Despite its potential to revolutionize urban areas, the smart cities planning model has failed to fully materialize in many economies due to financial constraints (Z. Allam & Jones, 2019b; Allam & Newman, 2018). The challenge, therefore, is to bring the concept of the metaverse to fruition without exacerbating economic disparities. Major corporations, tech companies, governments, and other stakeholders investing in the metaverse must consider the economic implications for those at the middle and bottom of the economic pyramid. It is imperative to ensure that the infrastructure, hardware, and software necessary for the metaverse are made accessible and affordable to all. This way, the metaverse can be a tool for progress rather than a source of economic inequality.

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Another significant challenge associated with the Metaverse is user privacy. Big tech companies, such as Facebook, have shown a lack of ability to address privacy concerns effectively. With the advent of the Metaverse, these companies will likely collect, share, trade, and potentially misuse users' personal information. This data can be gleaned from online interactions and biometric data from wearable virtual and augmented reality devices (Lee et al., 2021). This pervasive data surveillance, or "dataveillance," marks a troubling potential end to privacy. The level of data collection in the Metaverse is anticipated to exceed that of the current internet, further heightening these concerns.User addiction and the problematic use of virtual social media platforms present another challenge for the Metaverse. The immersive and three-dimensional nature of the Metaverse could lead to over-reliance and inaction in users' real-world functions and activities. This dependence could exacerbate existing mental and physical disorders, leading to severe repercussions. Given the complexity of these issues and the controversy surrounding the Metaverse, formulating evidence-based policy recommendations is challenging. Policymakers will need to navigate these thorny issues carefully to ensure the Metaverse is developed and implemented responsibly and equitably. The focus should be on creating a Metaverse that is not only technologically innovative but also ethically sound and considerate of our broader societal and environmental challenges. In summary, while the Metaverse presents an exciting potential future, it is not without its challenges. It is crucial that these are addressed head-on, with an emphasis on maintaining privacy, preventing over-reliance, and ensuring that the development of this new technology does not distract from other pressing global issues.

The concept of the Metaverse, like all techno-visions, is influenced by political practices, climate change, economic shifts (such as the transition to low-carbon and digital economies), ecological modernization, technological and scientific advancements, governance shifts, and the knowledge/power relationship in Western society (Bibri, 2014). These factors will shape, expand, and likely sustain the Metaverse's growth and success, at least for a particular period. The Metaverse can be philosophically viewed as a discourse on using computational and scientific approaches to social connection. This perception is inspired by recent technology advancements that typically gain popularity rapidly before fading as they become embedded in experiences. As Einstein posited in 1934, "All knowledge about reality begins with experience and terminates in it" (Einstein, 1934). The development of the Metaverse is still in its early stages, and research in this realm is in its infancy and fragmented across different disciplines. Therefore, this global platform's opportunities and implications are not yet fully understood. However, the concept of the Metaverse has already raised significant concerns about the risks and impacts of its core enabling technologies on human, ethical, and social values. Konkova and Gurov (2022) examined the reasons behind big tech companies' efforts to transform humankind's way of life and the nature of being "human" based on the Metaverse idea. They highlighted the opportunities and threats the Metaverse presents for humanity amid uncontrolled technological development. The authors called for the formation and dissemination of a new socio-humanitarian rationality as a prerequisite for the successful development of the Metaverse.

Should the Metaverse's concept be envisioned to play a pivotal role in future digital societies, it needs nurturing by tech enthusiasts and stakeholders. This inclusive approach would ensure that all possible pathways leading to unparalleled benefits are explored, leading to equitable and inclusive outcomes. Nonetheless, this process is not without risks, necessitating the identification of potential hurdles and solutions. Bibri and Allam (2022b) asked what ethical implications the Metaverse would have on daily life in urban societies. They examined the forms, practices, and ethics of the Metaverse as a virtual form of data-driven smart cities. They gave particular attention to privacy, surveillance capitalism, dataveillance, geoveillance, human health, and collective and cognitive echo chambers. The authors argued that the Metaverse could do more harm than good due to the widespread misuse of hyper-connectivity, datafication,

algorithmization, and platformization underlying the Metaverse's global computer mediation architecture. it is important to redefine the Metaverse in a way that acknowledges users' human characteristics, considers moral values and principles, and mitigates the negative effects of socially disruptive technologies. The goal is to realize the potential benefits of the Metaverse while minimizing its harmful impacts.

As we approach the brink of the emergence of a new 'universe' known as the Metaverse, it becomes crucial to confront and deliberate on some thought-provoking queries. One area demanding immediate attention involves the administrative structures that will operate within the Metaverse and their potential restrictions. Defining and understanding these structures' boundaries is anything but straightforward, yet it is instrumental in shaping how this digital world will function. Another question relates to the delicate balance between the physical and virtual realms. Could we foresee a system where activities conducted in the Metaverse gain legal recognition in the physical world? This becomes particularly relevant in the context of transactions involving virtual land and other digital assets. The presence of a system that acknowledges such activities legally can pave the way for a seamless integration of the physical and virtual worlds, thereby augmenting the overall user experience. One cannot overlook the possibility of the Metaverse, a digital imitation of our physical world, replicating existing biases and societal wrongs. As appealing as a mirror universe may sound, the reproduction of our world's imperfections could inadvertently lead to the digital propagation of these issues. Thus, it becomes critical to address this aspect while designing the Metaverse. The responses to these questions will play a significant role in sculpting the digital societies of the future. They will guide us in developing accessible, inclusive frameworks that are responsive to social needs and aligned with the Sustainable Development Goals (SDG 11). These goals will contribute to making cities and human settlements inclusive, safe, resilient, and sustainable, promoting prosperity while protecting the planet.

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