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The Social Shaping of the Metaverse as an Alternative to the Imaginaries of Data-Driven Smart Cities: A Study in Science, Technology, and Society

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Abstract: Science and technology transform the frontiers of knowledge and have deep and powerful impacts on society, demonstrating how social reality varies with each era of the world. As a set of fictional representations of technologically driven future worlds, the Metaverse is increasingly shaping the socio-technical imaginaries of data-driven smart cities, i.e., the outcome of radical transformations of dominant structures, processes, practices, and cultures. At the core of the systematic exploration of science and technology is the relationships between scientific knowledge, technological systems, and values and ethics from a wide range of perspectives. Positioned within science of science, this study investigates the complex interplay between the Metaverse as a form of science and technology and the wider social context in which it is embedded. Therefore, it adopts an analytical and philosophical framework of STS, and in doing so, it employs an integrated approach to discourse analysis, supported by a comparative analysis of the Metaverse and Ambient Intelligence. This study shows that the Metaverse as a scientific and technological activity is socially constructed, politically driven, economically conditioned, and historically situated. That is, it is inherently human and hence value-laden, as well as can only be understood as contextualized within the socio-political-economic-historical framework that gives rise to it, sustains it, and makes it durable by material effects and networks. This view in turn corroborates that the Metaverse raises serious concerns as to determinism, social exclusion, marginalization, privacy erosion, surveillance, control, democratic backsliding, hive mentality, cyber-utopianism, and dystopianism. This study argues that, due to the problematic nature of the Metaverse in terms of its inherent ethical and social implications, there need to be more explicit processes and practices for enhancing public participation and allowing a more democratic public role in its shaping and control, especially early in the decision-making process of its development—when the opportunity for effective inputs and informed choices is greatest. The novelty of this study lies in that it is the first of its kind with respect to probing the link between the Metaverse and data-driven smart cities from an STS perspective. The main contribution of this study lies in deepening and extending social scientific critiques and understandings of the imaginaries of data-driven smart cities based on the analysis and evaluation of the Metaverse and the warning signals and troubling visions it conveys and animates in order to help construct desirable alternative futures for the greater good of all citizens. The ultimate goal is to structure the Metaverse in ways that are morally acceptable and collectively the most democratically beneficial for society.

Keywords: Metaverse; science and technology; society; data-driven smart cities; socio-technical imaginaries; fictional representations; democracy; privacy; utopia; dystopia; surveillance

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1. Introduction

Advances in science and technology (S&T) shape the possibilities of what we can think, do, and imagine. There has recently been much enthusiasm about the future possibilities conveyed by the Metaverse as one of the recent manifestations of techno-scientific

progress due to the rising prospect that it will greatly impact society in the near future. The Metaverse has been perceived as a compelling and enticing socio-technical vision proclaiming that the immersive, persistent, transcendent, concurrent, shared cyberspace will be embedded with numerous types of sensing devices, pervasive computing systems, and wireless communication networks that can perceive, think, feel, and react to human users and their virtual representations in the form of avatars with multiple identities and characters. However, the whole idea of avatars is what still makes the Metaverse a fictional representation rather than a socio-technical imaginary in terms of its potential realization and delivery—with concrete social impacts. While socio-technical imaginaries are "future-oriented visions of connected social and technological orders, with more or less determinism built into them", they "can be seen to have the possibility of shaping terrains of choices and thereby of actions" [1]. However, the Metaverse is an idea of a hypothetical aways-on 3D network of virtual spaces where people can socialize, interact, connect, learn, work, shop, play, and many more thanks to the convergence of data-driven technologies and immersive technologies. The virtual worlds of the Metaverse are expected to be quite different from anything that human users have experienced hitherto, incarnating ways of living in believably virtual cities. This represents a new form of urbanism in the sense of "the distinctive features of the experience of everyday life in cities" ([2], p. 106) as digitally powered and data-enabled urban environments.

Research and development of the Metaverse has recently become a key trend in data-driven smart urbanism in terms of the design of virtual or augmented cities based on large-scale data-driven Artificial Intelligence (AI) systems. The concept of the data-driven smart city can be understood as a set of socio-technical imaginaries—performed visions of desirable future urban worlds enabled and sustained by infrastructures, services, activities, and more or less shared meanings of social life and social order [3]. The concept of the Metaverse can be understood as a set of fictional representations of future virtual worlds that convey warning signals and troubling visions, as well as future possibilities. In social scientific literature, fictional representations of technologically enhanced—in this case virtualized—urban worlds reflect the deconstructive critique of the techno-utopianism of urban imaginaries in technologically advanced societies frequently standing as symbols of socially alienating corporate and oppressive governmental power. Besides, the idea of the Metaverse tends to be largely based on unreasonable prospects that have limited modern applicability. Thus, the development of the Metaverse is, to a great extent, confined to conjectural or hypothetical boundaries. This is clearly manifested in how the Metaverse is attempting to reconfigure and reshape the relationship between citizens, urban places, and spatial forms. Regardless, what is certain is that there is no certainty that the Metaverse will actualize as a virtual form of data-driven smart cities, and that it is impossible that cities and urban life will disappear from people's perceptions in the future. In fact, the socio-technical imaginaries of data-driven smart cities are determined to be simultaneously constructed, reconstructed, transformed, and challenged, with each of these discursive processes and practices shaping the form of urban action—not to mention the fictional representations of future urban worlds. Moreover, the techno-utopian vision of the Metaverse points towards shaping "brand new, digitally powered environments [which] can too easily lead to limitations in how the social milieu is framed within them and exclude or render invisible specific social groups, cultures, practices of inhabitation, and places" ([4], p. 2). With reference to data-driven smart cities, social exclusion issues include the distortion of the "reality of a city" and the particularities of localities, such as the history, feelings, concerns, knowledge, and trajectories of urban communities [5]. As argued by Kitchin ([6], p. 11), they "need to be, framed as fluid, open, complex, multi-level, contingent, and relational systems that are full of culture, politics, competing interests, and wicked problems and often unfold in unpredictable ways". Instead, the Metaverse reduces this complexity into AI-based models and bounded and manageable digital platforms and then employs the outcomes to steer and control people and their virtual spaces. This produces a reductionist, atomizing, linear, rationalistic, and limiting understanding of how people interact with

each other and with their physical environment. This view is blind or oblivious to the human, social, and political complexity that characterizes the city and the effects of the future worlds it envisions. One implication of this view is that—as with data-driven smart urbanism—there is a lack of consideration of the experience of everyday life due to confining ways of living to the administrative boundaries of city systems [7]. In data-driven smart urbanism, "citizens become functional datasets to be managed and manipulated" in order to control urban ways of living ([8], p. 425). Similarly, as noted by Aurigi [4], much of the rhetoric around the Metaverse—as a combination of several control-freak urban utopias—echoes the "anti-urban, cyberspace-hailing hype of the 1990s".

Furthermore, the more immediate interest elicited by the Metaverse that has engrossed public attention has been challenged and questioned. This is due to the fact that the Metaverse emerged at times just when the world was grappling with greater uncertainties and challenges amidst the COVID-19 pandemic. Indeed, this crisis has exacerbated the issues of the increasing involvement of big tech companies in data policies, public trust in data governance, and data privacy risks through the accelerated adoption of digital technologies [9]. The crisis has accelerated and intensified the digital transformation of urban society, paving the way for a virtual form of platform urbanism [10]. Urban society refers to the social organization resulting from social (inter-)actions: the ways in which people act with other people and react to their ways of acting, as well as the interaction of people with the physical environment. As a "data-enabled and networked undergirding and intermediation of urban life" in contemporary urban society, platform urbanism has given rise to "new social and material relationships" [11]. It is primarily delineated by a novel set of digitally enabled socio-technical assemblages [12,13] of technology companies, service providers, users, consumers, and the resulting intermediations [14]. Worth noting is that platform urbanism originates in—and is seen as progression of—data-driven smart urbanism. However, as concluded by Caprotti, Chang and Joss [11], there is a need to critically engage with platform urbanism in regard to how it may shape visions of urban futures, as well as with its development in response to the COVID-19 pandemic. Especially, it has been argued that the digital transformation forced by the COVID-19 pandemic has not resulted in a greater good given the ethical, social, legal, and political issues and risks it has raised. Since the onset of this pandemic and its multifarious consequences have made it clear that its impact will not fade any time soon, and it will have a long-lasting impact on urban society and urban ways of living. These will be intimately and permanently interwoven with data-driven corporate-led technocratic governance.

Therefore, it has become of crucial importance to understand and find ways to address the risks and impacts of the rapid and massive rollout of digital technologies across every sphere of urban society with regard to surveillance, control, freedom, personal autonomy, privacy, cybersecurity, discrimination, and social exclusion, to name but a few [15–25]. These concerns are expected to exacerbate with the Metaverse [10,26–31]. Especially, the magnitude of the data to be generated by the Metaverse will be far greater than that being collected from the Internet today due to the immersive nature of its underlying technologies, adding to the controversies arisen because of the unethical practices of Meta as to data harvesting and exploitation.

The wide-ranging common socio-technical visions that are commonly brought about by scientific and technological advances involve both positive and negative impacts on society. The study of socio-technical imaginaries within Science, Technology, and Society (STS) focuses on exploring their material effects or harmful consequences [32]. The arguments and assumptions presented in the preceding background are positioned within the field of STS [33–36]. This involves the long-established debate, since the mid-1960s, on the role of science and technology in societal progress [3,37,38]; or on the relationship between S&T developments and socio-political institutions [32]. This study focuses on the convergence of the most innovative technologies underpinned by the "fourth paradigm of science" and associated with the "fourth industrial revolution", including AI and Machine Learning (ML), the Internet of Things (IoT), Edge Computing, Robotic Process Automation (RPA),

Nanotechnology, Blockchain, Extended Reality (XR), and 5G/6G. Schiølin [39] looks at the fourth industrial revolution as a socio-technical imaginary, and argues that there is a "future essentialism" in it, which limits democratic options. Generally, scholars have widely challenged the predominant forms of S&T, often raising doubts about the unquestioned beneficence of science and technology for society and exposing the problems and pitfalls of techno-scientific achievements. The demise of the notion of societal progress has been noticed since the 1990s [40].

This study argues that, as the development of the Metaverse is still in its early stages and research in this area is still in its infancy, fragmented along disciplinary lines, there is a little understanding of how the Metaverse has emerged from a range of perspectives and why it has become interwoven with policy, politics, and economics–global dissemination, as well as of its societal and ethical implications. Therefore, this study analyzes the complex interplay between the Metaverse as a form of S&T and the wider social context in which it is embedded. In doing so, it focuses on the intertwined factors underlying its materialization, expansion, success, and evolution, as well as the key contentions, bottlenecks, and uncertainties that have direct implications for its realization and acceptance. Accordingly, the Metaverse is discussed in terms of origins, visions, imaginaries, developments, technologies, trends, challenges, and issues. Therefore, it is approached from futuristic, technological, economic, social, political, ethical, and philosophical perspectives.

This study is structured as follows: Section 2 introduces, describes, and justifies the research methodology. Section 3 provides the results, which are structured into three subsections: (1) fictional representations and techno-urban and socio-technical imaginaries of future worlds, (2), performative and generative power and economic and technological driving forces, and (3) societal and ethical implications. Section 4 describes, analyzes, and interprets the findings. This study ends, in Section 5, with conclusions: findings, future research avenues, and contributions.

2. Methodology

Since the Metaverse refers to a vision of the Future of the Internet in society rather than being a current reality, it is to be situated early in STS. Thus, this study draws on interdisciplinary and transdisciplinary theories and insights from STS, and its methodological approach is descriptive and analytical. The technological, social, and user trends are reflections, postulates, and educated guesses as a basis for reasoning and discussion rather than being observed qualitative or quantitative current-day trends. The rationale for this is that this study is dealing with a possible future of techno-science in society. Further, the specific methodological focus of this study consists of a critical engagement with the discourses around the Metaverse and the claims made in the building process of its vision and in its projects, strategies, and policies. The Metaverse discourses, scenarios, and road-mapping activities provide the "thick description" to be read, analyzed, and deconstructed.

2.1. STS as an Analytical and Philosophical Framework

This study analyses how the Metaverse as a form of S&T links up with other societal developments in the prominent spheres of policy, politics, economics, culture, ethics, and laws. Accordingly, it is positioned within the research and academic field of STS. This is an analytical and philosophical framework that probes the ways in which different forms of S&T emerge and evolve and become institutionalized and socially anchored–interwoven with policy and politics and, thus, disseminated at the macro level. In short, this framework is applied to investigate S&T in its wider social context [34,36,38,41]. In this study, it is concerned with the relationship between scientific knowledge, technological systems, and the wider social system in which these are embedded. The latter system pertains to the "socio-technical landscape of politics, institutions, the economy, and social values" ([42], p. 131). Further, with its two main streams of scholarship, STS involves research on (1) the nature and practice of S&T and (2) the risks and negative implications of S&T for human, ethical, and social values. This study centers on the social forces that

shape the decisions and choices that are open to society with respect to the construction, adoption, and uptake of new technology. The Metaverse represents a global discourse of S&T in society that is at the intersection of scientific innovation and technological change and the social, political, cultural, and economic transformation of the world. The term "discourse" is defined by Foucault [43] as a group of statements which provide a language for talking about a way of representing the knowledge about a particular topic at a particular historical moment. Hajer ([44], p. 44) describes it as "a specific ensemble of ideas, concepts, and categorizations that are produced, reproduced, and transformed in a particular set of practices and through which meaning is given to physical and social realities". In addition, where a particular set of statements are ideological, it refers to a system of representations developed socially to create and circulate a coherent set of meanings that serve the interests of certain groups of society. For a detailed discussion on theoretical perspectives of discourse, including social practice, discursive practice, social representations, discursive-material dialectics, and discursive institutionalism, the interested reader might be directed to Bibri [45].

2.2. Discourse Analysis as Underpinned by Social Constructionist and Constructivist Approaches

As to the methodological orientation of this study, the purpose of the adopted STS framework is to highlight the futuristic, technological, economic, social, cultural, political, and philosophical perspectives on the Metaverse. Generally, STS employs diverse qualitative approaches, such as discourse analysis, comparative historical analysis, and cases and controversies, depending on the topic under investigation. This study espouses discourse analysis given the nature of the Metaverse being an emerging phenomenon or a speculative fiction narrative coming into prominence once more. Here, discourse analysis is supported by a comparative analysis of the Metaverse and the preceding socio-technical vision of Ambient Intelligence (AmI). Another reason for adopting discourse analysis is that this STS study deals with (scientific) knowledge constructions and the wider social context in which these are given form and meaning and ultimately applied [46]. As an interdisciplinary and transdisciplinary strategy, discourse analysis examines how understandings are semiotically constructed and materially produced in their societal context. In this study, it probes the Metaverse and its role alongside material mechanisms and practices in their translation into hegemonic projects and strategies and the institutionalization of these in social structures and processes. Accordingly, it combines and integrates the key strands of two main approaches: (i) Foucauldian Discourse Analysis (FDA) and (ii) Critical Discourse Analysis (CDA) given their overlapping and complementary nature. Both of these approaches see the use of language as a form of social action or practice. FDA focuses on power relationships in society as expressed through language and practices. It attempts to understand how the world is viewed, and examines categorizations, institutional relationships, ideology, and politics [43]. Steming from a critical theory of language, CDA analyzes opaque structural relationships of dominance, power, control, discrimination, inequality, hegemony, ideology, social order, reproduction, struggle, and so on as manifested in language [47]. Here, the word "critical" means not taking things for granted, opening up complexity, challenging reductionism and dichotomies, being self-reflexive in research, and proposing alternatives. Fairclough and Wodak [48] set up eight basic tenets of CDA as follows: (1) discourse constitutes society and culture; (2) the link between text and society is mediated; (3) discourse is a form of social action; (4) discourse is historical; (5) power relations are discursive; (6) discourse does ideological work; (7) discourse analysis is interpretative and explanatory; and (8) CDA addresses social problems. This study is guided by these principles, as well as the theoretical principles of Michel Foucault (i.e., the relationship between power and knowledge, subjectivity and social practices, subjectivity and power relations, discursive constructions, regime of truth, discursive truth, positivity, etc.), with respect to the deconstructive or critical reading of the socio-technical imaginaries of data-driven smart cities as embodied, imagined, and symbolized by the Metaverse.

Discourse analysis is one of the most used analytical approaches in social constructionism, as the discourses are of fundamental importance for constructing social phenomena, categories, and mechanisms as shared understandings of the social world. Thus, it is underpinned by a social constructionist approach to knowledge, which rests on several premises, including the historical contingency and cultural specificity of knowledge, the critical approach to taken-for-granted (scientific) knowledge, and the relationship between knowledge (and its discourses) and social processes and practices [49]. The main assumptions of this approach are: multiple categories of reality are legitimate, written works are open to multiple readings, and language is not a representation of reality. Both notable historians of S&T—Kuhn [50] as a philosopher of science and Foucault [43] as a sociologist of science—adhere to the premises shared by the social constructionist approach. Their work was instrumental in establishing that scientific knowledge and facts are not mere reflections or pure representations of reality—but rather outcomes of socio-culturally specific and historically and epistemically conditioned investigations, reflecting a more complete and nuanced understanding of the societal context of S&T and criticising the notions of objectivity within scientific knowledge. As a corollary to the constructivist approach, which also underpin discourse analysis, S&T are embedded and constructed accordingly, that is, they can only be understood within different contexts, which in turn provide different ways of knowing. Social constructivists have revealed the underlying values and ethics of the decisions made in scientific research and discovery and technological development and innovation. The social constructivist approach is concerned with human well-being and the social and ethical consequences of scientific and technological choices.

Within the framework of STS, discourse analysis entails a set of different theoretical and interdisciplinary approaches into orientating the analysis and evaluation of the material reporting on the Metaverse. There are "no clear consensus as to what discourses are or how to analyze them. Different perspectives offer their own suggestions" ([51], p. 1). In other words, there are no hard-and-fast or standard approaches to reading texts or identifying discourses, but rather a multiplicity of procedural choices—a set of selected analytical techniques, which provide different insights into the text and thus different outcomes. Discourse theory assumes an analysis of the material at hand and a translation of the analytical and philosophical underpinnings of STS into a practical methodological use. It follows that discourse analysis involves the identification of a set of dimensions of the scholarly and industry content that is most relevant to the social construction of the Metaverse—and that ought to be examined. It is considered as a deconstructive or critical reading of a set of relevant documents of various types, which inscribe themselves within the discourse or narrative around the Metaverse. The main data sources include: academic publications (e.g., prospective research, transformational roadmaps, technology forecasting and social change studies, social and policy-related impact studies of new technology, technical studies, critical studies, reviews) scientific reports, project reports, research and technology development documents, S&T policy, and so forth.

3. Results

3.1. Fictional Representations and Techno-Urban and Socio-Technical Imaginaries of Future Worlds

3.1.1. The Metaverse as Speculative Fiction and a Techno-Urban Utopia: A Historical Perspective

While the idea of the Metaverse has been around for three decades as a speculative fiction narrative, it is until recently that it came to the public fore with the rebranding of Facebook into "Meta" and other digital platform providers, gaining increased attention and recognition worldwide. So, the idea has been proposed for 30 years in fictional literature, such as *Snow Crash* [52], *True Names* [53], and *Neuromancer* [54], which picture a promising future about the Metaverse. Precisely, it originates from the cult science fiction novel named *Snow Crash*, written by the novelist Neal Stephenson in 1992. In the early 1990s, futurists took the idea at face value, incarnating users as avatars in unconnected virtual spaces, and hence found it difficult to connect them into one cyberspace. To put it differently,

the idea of the Metaverse had faced some challenges due to its inability to obtain acceptance in the consumer technology market. Nevertheless, the cyberspace has been steadily advancing since the widespread popularization of the Internet in the 1990s. The idea of moving from a set of unconnected virtual worlds to an integrated 3D network of virtual worlds—the Metaverse—has gotten off the ground due to the escalating trends towards the digital instrumentation, digital hyper-connectivity, datafication, algorithmization, and platformization of urban society, coupled with the youthful enthusiasm around interconnectedness: how more people and things can be closely connected in the universe [27]. Moreover, it has benefited from progress in ubiquity of access and identity, immersive realism, interoperability, and scalability [55], as well as the wide adoption of the social media platforms owned by Meta.

As with the idea of the Metaverse, there has been 30 years' development behind the evolution of the term "Metaverse". As a combination of "meta" (meaning beyond) and "verse" (universe), the term is rooted in the science fiction novel Snow Crash. Since its publication in 1992, the term has appeared in a series of books and movies, which have tended to interpret it in a variety of ways based on the kind of technologies used for entering the virtual world, thereby rendering it ambiguous or vague. Stephenson [52] describes the Metaverse as a virtual reality world that enables people competing against each other for social status to interact through their digital avatars as in the physical world. In 2018, the success of the film *Ready Player One* [56] brought the concept of the Metaverse back to the forefront of discussions. This film describes a virtual world in which everyone could customize their own avatars and connect to the virtual world and do everything they wanted to based on the basic rules using multimedia technologies such as VR/AR. In 2021, Meta claimed to adopt more advanced immersive technologies and defined the term accordingly as "a set of virtual spaces where you can create and explore with other people who are not in the same physical space as you. You will be able to hang out with friends, work, play, learn, shop, create, and more" [57]. The Metaverse now denotes the next-generation Internet in which the users can interact with each other as avatars in a 3D cyberspace. Some scholars have defined the Metaverse from a comprehensive technical architecture perspective. Lee et al. [30] describe it as a 3D virtual cyberspace merging the physical world and the digital world as enabled by the convergence between the Internet and Web technologies and XR [30]. Bibri and Allam [27] describe the Metaverse as an idea of a hypothetical 3D network of virtual worlds portrayed by its originators as a perpetual, concurrent, transcendent, immersive, and empyrean cyberspace where human users feel tangibly connected to everyday objects and to their real lives, bodies, and minds in the form of avatars with multiple identities and characters. As a working definition for this study, the Metaverse refers to a set of fictional or imaginary representations of a 3D network of virtual spaces enabled by historically conditioned and socially specific scientific knowledge and technological development that characterize the next wave of the Internet, the fancier successor of the Internet as a form of techno-science progress. Although there is no single or universally agreed definition of the Metaverse, a common thread running through all definitions is the convergence and combination of the IoT, Big Data, AI, AR, VR, MR, and 3D technologies.

In addition, Duan et al. [58] propose a three-layer architecture of the Metaverse: infrastructure, interaction, and ecosystem, introducing the decentralized ecosystem based on Blockchain. According to Lee et al. [30], the Metaverse consists of two dimensions: technology and ecosystem. The authors offer a comprehensive state-of-the-art review of the Metaverse with respect to the technological pillars that fuel the "Digital Big Bang" from the Internet and XR to the Metaverse, which support its gigantic ecosystem as application. In the Metaverse, users are represented by avatars to navigate a virtual world, which has strong links with the physical world. Stephenson's novel includes a number of concepts and ideas, including VR "headsets" and AR "googles" that allow people to immerse into a fictitious pre-virtual space. The Metaverse has widened the scope of VR and AR to include social interaction, workplaces, shops, leisure, entertainment, creativity, and more, providing

a multiuser platform for unlimited interconnected virtual communities and environments using VR headsets, AR goggles, and hand-held touch screen devices. MR is synonymous with AR, a combination of AR and VR, or an enhanced version of AR. But it is mainly seen as an advanced AR iteration in the sense that the physical environment interacts in a real-time fashion with the projected digital data [59]. However, a number of products have been initially geared to slowly mould users' perceptions towards the Metaverse, including Horizon Home, Future of Work, AR Calls, Gaming, Spark AR, Presence Platform, Fitness, Project Cambria (see Allam et al. [60] for a detailed account and a discussion in relation to future smart cities), and more yet to come as the concept becomes universally accepted and the platform evolves. Project Cambria is expected to yield high-end VR devices that will encompass the latest technologies. This involves new capabilities that are not possible with the currently available VR headsets and to provide virtual avatars with new capabilities [61] in order to allow people to interact more naturally in the virtual world and experience and view objects in the physical world in a more realistic way.

Furthermore, Stephenson's novel has also led to the emergence of a number of urban utopias during the 1990s. Among these are digital twin visions of "Mirror Worlds" [62], pollution and constraint-free living [63], and free-form designs and interactive capabilities of "Liquid Architectures" [64]. Much of the discourse around the Metaverse reflects the urban utopian hype of the 1990s [4]. Indeed, while the Stephenson's idea of VR did not capture the marketability interest of major platform providers and global technology sector, it has been taunted by several advocates as offering real prospects in virtual urban worlds and thereby attracted big tech companies. As a consequence, the Metaverse seems to be edging closer to reality by becoming a new target for existing smart cities to attain new goals. It is increasingly perceived as a transition from smart cities to virtual cities powered by the most innovative computing technologies and immersive technologies that are expected to create a parallel virtual world. This will, however, require loads of data to be brought into a digital form and a massive process of digitalization to enable the virtual kind of urban transformation. Nonetheless, in studying the effects of the emergence of virtual cities have on their perceptions compared to real-world cities, Hemmati [65] found that the Metaverse can create more believable images than reality. This relates to what has been termed "virtual urbanism" or "augmented urbanism" [66–68] in regard to the application of urban planning, urban design, and urban geography to the design of virtual and augmented urban spaces [10]. Accordingly, as a set of speculative or fictional representations of future urban worlds, the Metaverse is increasingly shaping alternatives to the socio-technical imaginaries of data-driven smart cities.

3.1.2. On the Forecasting of the Metaverse: From Speculative Fiction to a Socio-Technical Vision

Constructing the Metaverse—as a future vision for virtual (platform) urbanism—is based on technological forecasting given the extrapolation and prediction associated with the foresight through which it was envisioned by its originators. Fictional representations of future worlds are widely acknowledged to have a key role in futures studies, whether by imagining futures or conveying future possibilities [69–72]. In futures studies, they provide essential diverse and multidimensional imaginary "ways of knowing" [73], and making sense of them covers the institutional contours of imagined tomorrows [74]. One of the modes of thinking about the future based on which futures studies can be categorised is, according to Banister and Stead [75], probable futures—what is most likely to happen? Futures studies can also be categorized based on the simplicity and complexity of the context being investigated. With respect to the former, forecasting is appropriate when the context is predictable and largely controllable [76], which is the case in the Metaverse vision. Forecasting concerns "the extrapolation of developments towards the future and the exploration of achievements that can be realized through technology in the long term" ([77], p. 503). Technological forecasting is associated with different stages of innovation, including scientific findings, laboratory feasibility, operating prototype,

commercial introduction, widespread adoption, and diffusion to other areas and social and economic impact [78]. Accordingly, the socio-technical vision of the Metaverse is the result of forecasting, an approach to futures studies that involves the generation of a set of scenarios that corresponds to a future occurrence. The envisioned scenarios in the Metaverse have been built based on the analysis of both historical data and current trends as inputs to make informed predictions as to determining the direction of the future of the Internet. Thus, the Metaverse vision emanates from a probabilistic prediction of changes in terms of the future features of dominating innovative technologies as a set of machines, systems, procedures, techniques, and rules, as well as their role in advancing the notion of the cyberspace.

The Metaverse has engaged in defining the vision of future reality—what big tech companies want for future generations—in collaboration with a number of government S&T agencies, policymakers, institutions, technical research laboratories, universities, and a large number and a wide range of businesses and industries. The vision has been developed based on investigating radical advances in S&T, new trends, and other driving forces that have arisen from the dynamic interplay of different societal factors. Therefore, forecasting the Metaverse goes beyond anticipating scientific and technological advancements to include economic, social, political, institutional, and environmental changes to formulate and implement policy strategies. Forecasts can be made on how soon disruptive technologies or computing paradigms may be achievable and deployable and what characteristic features they may possess depending on various societal considerations [79]. These are considered as external non-technological factors that are normally beyond the ambit of the forecaster. Predicting future paradigm shifts in S&T and how these will affect society and the way people will live in it is well aligned with the endeavor of building future visions. As one of the techniques of technological forecasting, foresight has been employed to define the key areas of S&T that are vital for the development of societies and that should be prioritized for research and funding, to elaborate pathways of techno-scientific applications, to improve the quality of life, and to create wealth while considering environmental externalities [80].

Technology remains unpredictable, regardless of the time horizon set for the constructed visions where it can be instantiated to actualize. The Metaverse is expected to be realized by the year 2030, which will hopefully give scholars the opportunity to raise and address the critical issues and provoke the disturbing questions related to how it should be built and delivered for real social impacts. Despite the socio-cultural affinity regarding new technologies that reflect optimism, experiences have shown that futurists make poor forecasts. The restricted presumptions of major change to possibly occur makes technological forecasting fail to reach its goals [81]. One of the main problems that lead to faulty predictions is the inconsistency between forecasts in terms of generating inaccurate and unreliable data with regard to time and location factors [82]. Moreover, technological forecasting tends to present a more limited range of options, and project the current problems into the future [83], as well as neglect and postpone the present challenges and issues. In addition, past forecasting studies have shown that ignoring the (social) fields related to technological forecasting is one of the reasons why forecasts go wrong [84].

The Metaverse is currently more a vision of the future of reality than a reality. It is per definition normative, that is, a certain desired view on the virtual world as depicted in its envisioned scenarios—according to its originators or creators. Like the discourse of data-driven smart urbanism, much of the rhetoric around the Metaverse is deeply originated in normative visions of the future where the salient driving factor for social transformation is technology and its advancement. Hence, it is useful to engage critically with the unrealistic assumptions underlying the Metaverse based on futuristic predictions. Often permeating visionary scenarios [85], the unreasonable assumptions made in the socio-technical vision of the Metaverse pertain to the prospects that have little modern applicability as to how society and technology will evolve in a mutual process, and thus whether and the extent to which people in that society will accept that technology. Eventually, the impracticality of the virtual worlds of the Metaverse will result from the oversimplification and underestimation

of the grand challenges involved in the development of the Metaverse, of the way in which the envisioned scenarios are to be converted into reality, and of how human users should be pre-configured in the vision. Regardless of their innovative and futuristic nature and thus power to spur actions, visionary scenarios should be considered with caution and moderation. They remain, as applied to the Metaverse, constrained and distant from reality to deliver concrete value to human users in regard to the benefits of the so-called virtual services. Regardless, while the public hopes and concerns relating to the Metaverse engage in unpredictable and dynamic ways with forms of the imagination of future-life worlds, people also construct and act upon their own imaginaries of those in power and hold policymakers accountable in accordance with their explicit notions of scientific innovations and their technological applications and of public good, progress, legitimation, and uncertainty. Nonetheless, fictional future worlds can be viewed as a means to tap into the "implicit understandings that lay beneath the surface of society, and even our scholarship" ([86], p. 123), as well as unconsciously held assumptions [74]. As known from the preceding socio-technical visions and forecasting studies, the future reality in society is most likely to end up being very different from the way it is initially envisioned. Indeed, socio-technical visions appear to face a paradox in ways that fail to balance between innovative and futuristic claims and realistic assumptions.

Worth noting, however, is that most of the issues related to the forecasting of socio-technical visions—and a plethora of other inherent limitations—have also been a subject of much debate concerning AmI ([87–93]). AmI is described by Information Society Technologies Advisory Group of the European Commission [94] as a vision of the future of information society where "humans will be surrounded by intelligent interfaces supported by computing and networking technology which is everywhere... AmI... is aware of the specific characteristics of human presence and personalities, takes care of needs and is capable of responding intelligently to spoken or gestured indications of desire, and even can engage in intelligent dialogue. AmI should also be unobtrusive, often invisible: everywhere and yet in our consciousness—nowhere unless we need it. Interaction should be relaxing and enjoyable for the citizen, and not involve a steep learning curve". This description points out some of the most fundamental ideas in what has come to be identified as the Metaverse vision: the idea of a technologically data-driven radical change to people's everyday lives and environments. Emerged in 1999, the AmI vision has never been deployed and delivered in spite of the many years of intensive research and development (R&D), or realized according to how it was envisioned by its creators and advocates, despite the institutional government support provided by the European Union. More than a decade ago, José, Rodrigues and Otero [95] concluded that the field of AmI was at a tipping point where it needed to confront its expectations with reality and to deliver its promises, predicated on the assumption that the then available technology was already enough to achieve a lot. Therefore, AmI could "no longer be about a vision of a new world for the future... [It had] the obligation to start delivering valuable services, not for the future or the constrained environments of the labs, but... for the messiness and imperfections of the real-world" ([95], pp. 1497–1498). In fact, all socio-technical or techno-utopian visions promise futures where advanced technologies offer ideal solutions or panaceas to the pathologies of society or the city. Descriptions of techno-utopias typically invoke pejorative meanings [96,97]) connoting a hopeless fantasy that will never be realized [98], or ideological claims that obscure the actual interests shaping societal progress [97]. Likewise, socio-technical imaginaries "reside in the reservoir of norms and discourses, metaphors, and cultural meanings out of which actors build their policy preferences ([32], p. 123).

3.1.3. Socio-Technical Imaginaries: Utopianism, Determinism, Ideological Claims, and Cultural Frames

In recent years, the relationship between urban life and virtual life has become a topic of importance as to how they interact with and affect each other. This has been accompanied by the emergence of a new wave of fictional and imaginary representations of future urban

worlds, which are increasingly transforming the city and urban life through the institutional dimensions of platformization. This process refers to "the penetration of infrastructures, economic processes, and governmental frameworks of digital platforms in different economic sectors and spheres of life, as well as the reorganization of cultural practices and imaginations around these platforms" ([99], p. 1). Bibri, Allam, and Krogstie [10] provide a detailed discussion of platformization with respect to its underlying processes, institutional dimensions, and disruptive impacts within the framework of the Metaverse. Worth pointing out is that platformization shapes the way in which the city and urban life are imagined experientially. One clear illustration of this is how smartphone-based platforms are enabling alternative views of urban life as a series of behaviors, relations, interactions, and service pathways, where some urban/spatial features and areas of urban experience are made prominent and others are left obscure. Scholars have long explored both fictional representations and social-technical imaginaries of the city and urban life and their role in shaping urban change [100–103]. Accordingly, the Metaverse is increasingly shaping urban society and ways of living in it and the perceptual interactions between people and spatial forms. It has been associated with spatial imaginaries [60] in relation to urban forms. Spatial imaginaries, as shared or collective understandings of space, are representations or "cognitive frameworks, both collective and individual, constituted through the lived experiences, perceptions and conceptions of space itself" ([104], p. 410), and as such, they co-constitute social practices and have material effects [105]. Chateau, Devine-Wright and Wills [106] argue that they are highly compatible with socio-technical imaginaries and facilitate analyses of their role in the construction of space, thereby their performativity. The authors affirm that urban society is "constituted in time and space and as space is both a social product and an essential dimension of the social, socio-technical imaginaries *must* have a spatial dimension". However, the ability to make sense out of the spatial experience in smart cities is troubled [107,108]. Strüver and Bauriedl [109] engage with the socio-spatial implications of platform-mediated urban everyday life and urban futures, including a rigid techno-dystopian stance.

The COVID-19 crisis has forced new ways of living digitally in urban society, drastically changing urban landscape in terms of the evolving urban patterns and the shifting nature of urban life. The abrupt digital transformation that has swept through the urban world in the wake of this crisis, coupled with its disruptive impacts on people's everyday life, seems to be in tandem with the envisioning process of the Metaverse in terms of its ultimate goal to datafy, algorithmize, platformize, and ultimately virtualize urban ways of living [10]. Technological advancement has changed the nature of the work environment, with most people favoring work-from-home models, as it has become increasingly possible to communicate, collaborate, and fulfil different work-related tasks without visiting physical workplaces [60]. This trend was amplified during the height of the COVID-19 pandemic, signalling the extent to which new technologies have transformed the work environment by providing unlimited alternatives and conveniences [110]. This crisis has triggered new ways of working digitally across the globe, and VR/AR technologies offer a potentially effective solution [111]. The development of the Metaverse is argued to bring ultimate changes to the global workplaces, with diverse tools and different possibilities [112]. However, human interaction among families, friends, groups, and communities enrich social bonds and strengthen resistance. This is crucial for protecting civil liberties, which have, in fact, been severely affected as a result of the "new normal", and their erosion continue to be progressively normalized thanks to the draconian measures imposed during the COVID-19 pandemic and the surveillance technologies put in place and which will not be turned off after the crisis. By interacting with and reacting to each others, people design practices, institutions, and policies as part of the social system within which they seek to live and thrive. One of the criticisms of a techno-utopia is that it will lessen human contact, leading to a distant and fragmented society with negative social effects as a result of its addiction to digital technologies to the extent that people simply cannot be parted from them even for the greater good of humanity. It follows to argue that the Metaverse is a set of steps

towards a utopian world in which people can easily and conveniently contact and interact with each other regardless of time or location, thereby eliminating connections between society and the grouping of its members, i.e., fragmentation. Therefore, there is a need for rethinking urban imaginaries in relation to the urbanism where so much of everyday life is now digitally mediated and evolving into becoming virtually mediated.

The realities of "techno-urban imaginaries" [113] depart from slick sales pitched by corporations and arrive to new urban realities [114–117]. This highlights the performative power of techno-urban imaginaries that is actively drawn upon to construct future visions [102]. Socio-technological imaginaries essentially involve, in addition to state actors, non-state actors (e.g., corporations, NGOs, foundations, expert bodies) that operate with their own imaginaries of how the social world should be organized [118]. Indeed, the latter actors are—in addition to governments, academic institutions, universities, and civil rights groups—collaborating with Meta to build the Metaverse [57]. However, the "collectively imagined forms of social life . . . reflected in the design and fulfilment of . . . technological projects" ([32], p. 120) pertaining to the Metaverse are questionable because they are largely unilateral and do not include the views of people, nor explicit participatory mechanisms for enhancing public participation in the shaping of the Metaverse as form of techno-science. The policies built upon socio-technical visions justify, drawing on insights from STS, the exclusion of people in terms of the benefits of new technology. Regardless, as a set of fictional representations of future urban worlds, the Metaverse is being mapped by Meta and other big tech companies as well as societal actors to generate policies, actions, and innovations. In this respect, it highlights how some aspects of society—social life and order—will evolve and how they will shape the future of reality. Still, socio-technical imaginaries are, in general, not the same as policy agendas [119], "problem frames" [120], and formal programs of action—not to mention fictional representations. Rather, they are less politically accountable, less goal-directed, less issue-specific, and less instrumental [32]. For a detailed philosophical discussion and the social and cultural concerns of socio-technological imaginaries, the interested reader might be directed to Bibri [118], a detailed interdisciplinary and transdisciplinary study that analyzes AmI as science-based technology in social context by delving deeper into the complex interplay between advances in S&T and other dimensions of society.

However, the future lifeworlds portrayed by the Metaverse are argued to be part of the leitmotif in the contemporary battles of the corporate and governmental elites to datafy, algorithmize, platformize, and virtualize urban society to advance hidden agendas—with harmful consequences. The virtual life-worlds touted by the Metaverse that people may experience together and that include individual, social, perceptual, and practical experiences, are part of grand narratives of human 2.0 and of broad historical narratives of change. However, the ways in which human users are pre-configured in the socio-technical vision of the Metaverse may be one of the key reasons why no real breakthrough in research and development of the Metaverse will be perceived, regardless of the time and effort put in the R&D projects and programs pertaining to the Metaverse in academic circles and in the ICT industry—similar to AmI [87]. It follows that, given its social and economic flaws and biases, the Metaverse cannot be considered as one of the "master narratives" [121], which are often "extrapolated from past events and serve explanatory or justificatory purposes, imaginaries. . . project visions of what is good, desirable, and worth attaining for a political community; they articulate feasible futures" ([32], p. 123).

The discourse of the Metaverse constructs it as being a 3D network of virtual worlds that will respond to the needs and desires of human users. In futurism, the idea is still depicted as a form of a hypothetical iteration of the Internet as a result of its ongoing shift from a net-like to brain-like architecture. However, the prospect that a single, universal virtual world might become the new reality depends on a plethora of intertwined scientific, technological, economic, social, cultural, political, and institutional factors. The complexity, intricacy, and dynamics characterizing how these factors affect and prevail over one another in terms of shaping the development of the Metaverse point to uncer-

tainties or unpredictabilities as to whether it will actualize and be widely deployed as a global platform. This adds to the fact that the prevailing assumptions and driving forces behind the Metaverse are based on a deterministic view of S&T. This involves the focus on technical advancements that are mainly driven by economic gains, industrial competitiveness, and political ends. Socio-technical or techno-urban imaginaries ignore the risks of technologically determined futures [90,102]. Technological determinism is central to utopianism. The hegemonic corporate strategy and rhetoric allied to the technological fetishization [122] that presents techno-urban imaginaries as an "obligatory passage point" for urban transformation raises the core concern about technological determinism in terms of its limits [96,122].

Similarly, the central features of the Metaverse in terms of its orientation towards technological advancements and their potential only in regard to the imaginaries of virtually inhabitable cities is being challenged and questioned due to similar concerns [10]. Socio-technical visions raise a central issue: that they are technologically deterministic, ignoring the user and social dynamics involved in the innovation process of technology. This is because they have a simplistic account or lack a holistic view of how social transformation occurs [123], and how human users behave towards technology. It is safe to argue that the realization of the Metaverse will depend on the social dimension of technology innovation and the participative and humanistic dimension of technology design. That is to say, the ability and willingness of human users to absorb or acclimatize to the opportunities being offered by the Metaverse, as well as their active involvement in the design process. Gurov and Konkova [29] conclude that for a successful development of the Metaverse, it is of crucial importance to adopt "a new socio-humanitarian rationality", predicated on the assumption that this approach will allow control over the activities of big tech companies to be ensured. However, in the light of the negative impacts that the social media platforms owned by Meta have had on urban society, coupled with the plethora of thorny issues they have raised, over the last two decades, the Metaverse will most likely fail to justify scientific and technological advances and investments in terms of linking them with societal development. That is, with the advancement of the conditions of urban society and how people live and thrive in it based on prevailing values, norms, beliefs, and goals. Societal progress entails that the current conditions of society are improved compared to the past, and that these conditions are envisaged to be better than those of the present [124].

As with all the preceding socio-technical visions, the claims and promises made in the envisioned scenarios of the Metaverse are overall unrealistic and optimistic, respectively. This is part of the process of vision building, nevertheless. It is important to acknowledge the persistent and significant gaps between the claims and promises made in socio-technical visions and their actual achievements—in the rather still unknown or uncertain future. Unrealism and optimism concern the claimed tremendous potentials and enormous benefits of the Metaverse. Rosenberg [31] concludes that the immersive technologies of the Metaverse "have the potential to make our lives magical, unleashing creativity like never before, even expanding what it means to be human". Duan et al. [58] claim that the Metaverse regarded as a "human-centred computing" platform "shows a significantly positive impact on the real world, especially in terms of accessibility, diversity, equality, and humanity". However, Gurov and Konkova [29] draw attention, based on a comparative analysis, to the opportunities and threats of the Metaverse as to humanity—if the development of the underlying core technologies is left uncontrolled. In this line of thinking, Allam et al. [60] provide an overview of the hypothetical contributions of the Metaverse as a virtual form of smart cities to the environmental, economic, and social goals of sustainability: the quality of life, resource management, social interaction, tourism, climate change adaptation and mitigation, global economy, and urban form. The authors also point to the grand challenges pertaining to the Metaverse concerning these areas. The main argument is that ungrounded claims are typical for socio-technical visions, lack a sound basis for action, and are not provided with justifications. The vision of AmI claimed in 1999 to contribute to "the enhancement of the quality of people's life, the modernization of the social model, the

improvement of the economy, and the protection of the environment" ([118], pp. 109–110). For more detail on the contributions of AmI as an advanced form of ICT, the interested reader might be directed to ISTAG [125].

However, Meta and other big tech companies, as well as scientists and researchers who might be biased to their funding grants, evangelize the Metaverse and paint its promises in sunny colors, touting them as a step towards a better world that could satisfy a blatant wish for a technological heaven on earth. Socio-technical visions are inherently associated with unrealism. This is in fact the paradox that they face—"the more innovative and revolutionary they become, the less they will be grounded in realistic assumptions" [90]. While it is critical to create an appropriate balance between the two, it is an extremely challenging endeavor to go behind the recurring unilateral claims of new consumer technologies, which are more often than not created to carry a certain meaning in accordance with the wider social context where they are embedded. In a nutshell, socio-technical visions are determined to endure an imbalance between realistic assumptions and futuristic predictions. Therefore, the complexity surrounding the Metaverse as a potentially transformative technology requires cautiousness. This implies that it might fail at worse—or underachieve at best. This is inherently characteristic of all the preceding socio-technical visions, such as the electricity, the steam engine, the television, the automobile, the mobile phone, the computer, and even the Internet.

Looking back to the time when "old technologies were new" [126], it can be useful to put the rhetoric about the technology-driven radical change to people's lives in the future into perspective. A century or so ago, electricity was socially constructed as the "fuel of the future", with promises for a clean, healthy, and efficient way of life [127]. This contradicts the current reality where most of electricity is generated from coal and fossil fuels, raising concerns over the environment. In recent years, environmental innovations and energy transitions have become high on the agenda of the European Union (EU), the United Nations (UN), and other international organizations. As a result, the world is witnessing a plethora of actions, innovations, and policies that are expediting energy transitions away from fossil fuels towards zero-carbon energy production. It is highlighted that the energy sector accounts for approximately 35% of the total global emissions, with households (consuming approximately 29% of global energy) emitting 21% of the 35% attributed to energy sector [128]. The aim of rapid and deep decarbonization is claimed to affect all sectors of society, especially energy which is crucial for transitioning towards low-carbon societies. According to United Nations Framework Convention on Climate Change [129], equipping governments to take up the challenge of advanced data management and analysis models will further play a critical role in meeting the decarbonization agenda as emphasized during the COP 26 summit. This again connects well with the objectives of the Metaverse as to its contribution to mitigating climate change in future virtual cities [60]. However, just like the discourse of electricity which "served the purposes of the industry looking for ways of using the electricity network outside working hours, i.e., in the home environment. . . at the end of the 19th century" [90], the Metaverse is serving the purposes of the ICT industry looking for ways of using the Internet beyond social media platforms.

It seems that history is about to repeat itself again, the virtual world enabled by the Metaverse is ideologically and symbolically represented in Western society as, like AmI, "a haven from the pace of modern life" [94]. Experts are indeed concerned that the Metaverse could be used as an "escape" from reality—escapism. Fictional and imaginary representations both convey warning signals as well as embody and symbolize futures [70,71] that can provide alternative views on how the future can be understood and framed [69,130] and ways of expanding this understanding and changing this framing. Additionally, as noted by Bibri ([118], p. 111), techno-utopian visions can be extremely captivating and inspiring when technologies of creative destruction or disruptive innovation nature get released into society. In this light, the Metaverse seeks to drastically transform the future of social reality based on the recent innovations in S&T. As with the preceding discourses surrounding the advent of new science-based technologies, it again promises better, happier, and pleasant

future worlds, a set of fictional representations that have some potential to frame and shape the development of society. To put it differently, with the Metaverse popping up again, a revolutionary social transformation is being promised this time on the basis of breakthroughs and innovations in Big Data, AI, the IoT, and XR as enabling, integrative, and constitutive technologies whose transformational effects could be unlocked and leveraged in the advancement of the conditions of society and people's lives. Similarly, in relation to AmI, ISTAG ([125], p. 2) states, "ICT does not just enable us to do new things; it shapes how we do them. It transforms, enriches and becomes an integral part of almost everything we do…ICT becomes more deeply embedded into the fabric of…society…These constitutive effects amount to a paradigm shift in how our…society functions". As added by ISTAG ([94], p. 8), it is important not to "underplay the radical social transformations that are likely to result from the implementation of the AmI vision". These cultural frames are linked to the role of S&T in social development, and are being shaped by the structural discourse of the Metaverse. According to Fisher ([131], p. 5), cultural frames refer to "socio–culturally and cognitively generated patterns which help people to understand their world by shaping other forms of deep structural discourse". The Metaverse has largely been brought to existence through strategic economic and political actors and their cultural frames that are conventionalized by and attuned to the values and norms of technologically advanced societies. Therefore, as a visionary imaginative work, it possesses "the performative and generative power to harness technological, social-psychological, cultural, political, and moral imaginations into a collective quest for a new reconfiguration of human–world relationships" ([89], p. 31). The prominence of socio-technical imaginaries of the future lies in that they have the power not only to catch peoples' minds and imaginations, but also to inspire them into a quest for new possibilities and untapped opportunities and to challenge them to think outside common mindsets.

3.2. Performative and Generative Power and Economic and Technological Driving Forces

3.2.1. The Metaverse as an Enticing and Inspiring Visionary Imaginative Endeavor

The historically situated action of launching and developing the Metaverse seems to have exerted control, or have had a remarkable power, over so many societal actors and their future actions across the globe. This pertains to the power of language used by Meta and in the Metaverse scenarios to effect change in the world beyond its description, functioning as a form of social action—in short, performativity. As a visionary imaginative endeavor, the Metaverse has been undertaken to achieve certain politico-economic and socio-political end goals that will bring some kind of fulfilment by means of socio-technical systems that bring communities together with new technologies. The purpose of building the Metaverse vision is to depict plausible futures, to make promises, to gain momentum, to maintain motivation, to stimulate inspiration, to capture imagination, and to provoke discussions. And crucially, to mobilize financial resources, to attract human and social capital, to orientate technological investments, and to engage and align the involved strategic actors into the same direction, which are regarded as a critical function of transformational roadmaps. These in turn lead to the creation of research roadmaps and systemic roadmaps [30,132]. The Metaverse vision began its influential role in 2021 in the after-effects of the COVID-19 pandemic outbreak, when the World Economic Forum (WEF) published a set of reports advancing the unilateral claim that this crisis is a rare opportunity to reimagine the world. This has in turn given Meta a prominent role in advancing the "Great Reset" agenda as well. The subsequent connection of the Metaverse with the "new normal" in the wake of the COVID-19 pandemic, coupled with the immense and continued financial backing of the research programs of the Metaverse, has made it a very active research topic within academic and industry circles. In the late 2021, Meta announced numerous collaborative partners across the world from industry, business, governments, nonprofits organisations (NGOs), research institutions, universities, and even civil rights groups to build the Metaverse [57]. Set to dramatically increase in the near future, these partners include: Colorintech (UK), Alte Nationalgalerie (Germany), and Peres Center for Peace and Innovation (Israel), in addition

to other institutions across the globe to facilitate independent external research with, such as Seoul National University, the University of Hong Kong; the Centre for Technology, Robotics, and AI; National University of Singapore; Howard University.

This visionary work has emerged as an interdisciplinary field that is concerned with social, psychological, political, cultural, scientific, artistic, and other dimensions of the Future of the Internet and related advanced ICT. It has attracted considerable research, funding, and public attention, which has led to many research programs and industry consortia across numerous business and industry domains focused largely on the technological features of the Metaverse. From its inception, the field of the Metaverse is strongly driven by a particular vision of how advanced ICT would shape the digital future of social reality. This has given the Metaverse vision, essentially as proposed by Meta and other big tech companies, an excessively central role in setting the research agenda of the field. While this agenda is expected to undergo many changes in the short and medium term in response to further advancements in the core technologies underlying the Metaverse, it is already pushing the global market towards unparalleled profitable paths. Meta and other globally operating platform companies, as well as large corporations, have begun investing billions of dollars to deploy the Metaverse given the rising prospect that it will greatly impact society over the next decade, being perceived as the next major evolution phase of the Internet [26].

The Metaverse is anticipated to open new economic frontiers that are poised to attract lucrative investments with substantial profit margins. As a result, a vast number of heterogeneous resources are being committed by these companies and corporations toward gaining substantial influence in this evolving computing platform. Rees [133] reports that at least eight tech giants have already invested over $10 billion in the Metaverse, amounting to financial resources, hardware infrastructure, and software applications targeting high returns as the platform continues to gain footing and traction. As regards XR, for example, the global AR, VR, and MR market was forecast to reach USD 30.7 billion in 2021, rising to close to USD 300 billion by 2024 [134]. It is also anticipated that, following the current interests in XR, there are possibilities that the consumer market would grow to approximately USD 125.2 billion by 2026 [135]. The market value for AR glasses is projected to grow from the current estimated value of USD 7 billion to 157 billion by 2030 [136]. As of October 2021, the market cap was estimated to reach USD14.8 trillion, while the economic potential ranged from USD 3.75 trillion to USD 12.5 trillion [137]. Bibri and Allam [26] discuss further the financial gains and economic performance of the Metaverse, and Johnson [138] provides recent statistics and facts on the market capitalization of the Metaverse, Meta, and gaming worldwide. Lee et al. [30] also discuss in more detail the industry's market structure of the Metaverse as illustrated in Figure 1. All in all, the market capital and the economic potential of the Metaverse are so enormous that it becomes clear that its development is purely driven by technological advancements and conditioned by economic partnerships, which can eliminate barriers to the free movement of products, services, and investment between countries as hinted at earlier. It follows to argue that the Metaverse overlooks the other dimensions of society—ethics, cultures, and laws.

The ways by which socio-technical imaginaries of future worlds are constructed have politico-economic and socio-technical implications for future R&D priorities. For industry and scientific research, the socio-technical vision of the Metaverse functions as springboards for ideas about what kind of technologies, developments, transformations, economy, markets, society, and world are necessary to arrive at such vision. As a result, the Metaverse has been considerably used as a buzzword [139] to exaggerate development progress for various technologies and projects with respect to public relations [140]. Vision description has never been, and will ever be, an innocent activity. This applies to all the preceding socio-technical visions. The argument is that the envisioned normative and indicative scenarios of the Metaverse—for a better world for the prototypical individual user—form the foundations of politico-economic decisions, which partnerships will be formed, which research projects will be financed, which applications will be developed,

and which markets will be created and explored. This also applies to AmI which was "driven by overblown research agendas focused mainly on technological features" [95] for similar purposes [88]. Socio-technical imaginaries "are associated with active exercises of state power, such as the selection of development priorities, the allocation of funds, the investment in material infrastructures, and the acceptance or suppression of political dissent" Jasanoff and Kim ([32], p. 123).

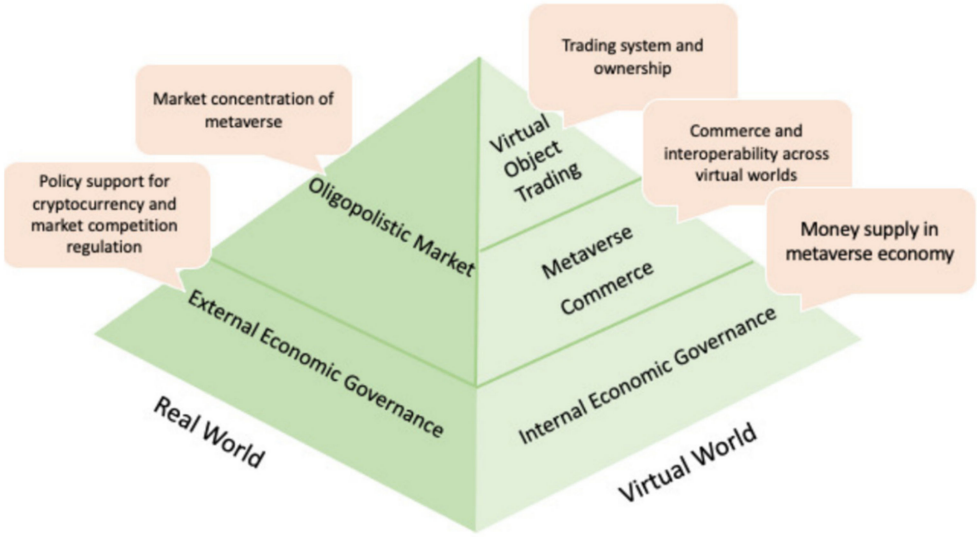

Figure 1. The industry's market structure of the Metaverse. Source: Lee et al. [30].

However, with respect to the envisioned scenarios of the Metaverse. big tech luminaries are preaching the next wave of the Internet—as a cyberspace for a better life in terms of ease-of-life apps, ease-of-work apps, social networking, interconnectedness, entertainment, leisure, and online video gaming. In this regard, the Metaverse claims a supremacy of networked, digital technologies for achieving greater effectiveness in managing services; providing new services around living, working, and entertainment; developing greater social interaction settings, work environments, and community networks; and enabling sharing economy and e-governance platforms. The envisioned scenarios of the Metaverse are extrapolations from the present into the future—based on computer designers' view of what should be better in their own lives and of how the future of reality should be. The main focus is on the technological features of everyday life, the ways in which people typically act, think, and feel on a daily basis, in the hyperconnected, datafied, algorithmized, platfomized, and virtualized urban society. This benefits the more fortunate and punishes the unfortunate [141], which require deep reflection on the ethical and social implications of the digital transformation of urban society [18]. Expanding the global market for new technological products and services often ignores their wider impacts on people as users and consumers and supports never-realized noble ideas and goals as claimed in socio-technical visions. Hence, consuming the Metaverse must be approached carefully because big tech companies as centralized structures often have hidden, and are driven by, economic and political motives [26]. All in all, socio-technical visions, and "the policies built upon them, have the power to influence technological design, channel public expenditures, and justify the inclusion or exclusion of citizens with respect to the benefits of technological progress" ([32], p. 120).

3.2.2. The Core Enabling and Driving Technological Trends of the Metaverse

The Metaverse has been made possible by the rapid pace of progress in the development of the core enabling technologies, notably AI, Big Data, the Internet Things (IoT), Edge Computing, Blockchain, Digital Twins (DT), Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and high-speed 5G networks. While these technologies are not of equal importance in terms of enabling the Metaverse as a "sophisticated" computing

platform, their convergence has expedited the integration of the independent virtual spaces owned by various high-tech and platform companies [10]. Several studies have addressed the state-of-the-art and technical aspects of the Metaverse in terms of the convergences of computing technologies and immersive technologies [30,58,142,143]. At present, the focus of the Metaverse is to build a decentralized computing platform that convenes numerous sub-platforms based on computational-immersive mediations. Innovations in platforms are increasingly unfolding around VR, AR, and MR. These immersive technologies fall under the umbrella term of XR through which human users can access the Metaverse, as it bridges the virtual entities with the physical environments together to create the so-called post-reality universe. These technologies are associated with the fourth wave in technology, which is seen as the next paradigm of UbiComp—the Metaverse—subsequent to AmI and the IoT—with resect to a large number and wide range of applications across various urban sectors and spheres of urban life.

A decade ago, Dionisio, Burns and Gilbert [55] described the then status and needed developments to achieve the Metaverse, highlighting factors that support its formation, especially advancements in hardware performance, and factors that constrain its realization, especially limitations in computational methods. These factors continue to be the topic of focus in the development of the Metaverse [30,58], in addition to the unrealized collaboration among platform providers as stakeholders and developers, which is the object of the next subsection. Nevertheless, it is expected that the advance and ease of accessibility to the digital tools and products will prompt their ready acceptance and adoption. Meta already owns four of the top six social media platforms, in addition to Oculus VR gaming which could be a gateway into the Metaverse. Oculus Quest 2 VR gaming headset can cunningly outwit human users to see, or trick their eyes into seeing, in a 3D virtual world. The announcement about the plans for Meta in collaboration with other big tech and platform companies to focus on this frontier has stimulated great interest in the application of immersive technologies to social reality. While the VR headset will be used to access the Internet of the future, it is not yet clear how and whether this will happen as VR headsets, albeit made lighter and more affordable, are primarily used by gamers—which is only a niche group. In order to gain further insights into the Metaverse in this regard, the interested reader might be directed to Lee et al. [30] who provide a detailed review of the technological pillars of the Metaverse as a giant ecosystem application.

Furthermore, the Metaverse is a product of the convergence of the escalating digital and computing trends enabling and driving data-driven smart cities. These trends are routinely permeating the very fabric of everyday life in urban society. Data-driven smart cities represent an immersion in a process of digitization and digitalization enabled by the convergence of the IoT, Big Data, and AI and its far-reaching consequences—digital instrumentation, digital hyper-connectivity, datafication, algorithmization, and platformization [10]. These also pertain to the global architecture of the computer mediation underlying the Metaverse as a virtual form of data-driven smart cities. Among the technological pillars of the Metaverse as a giant ecosystem application are user interactivity, XR, computer vision, AI/blockchain, robotics/IoT, edge cloud, wireless networks, and hardware infrastructure [30]. Bibri, Allam and Krogstie [10] propose an integrated framework, which is derived based on thematic analysis in terms of the core dimensions of the digital architecture of the computational mediation of the Metaverse. The basic idea revolves around the integration and combination of the same digital and computing processes enabling data-driven smart cities to build the Metaverse as a free-form design of virtually inhabitable cities or digital twin of cities.

The wide deployment of new networked, digital technologies embedded into the fabric of urban society has enabled new forms of fast, exhaustive, dynamic, contextual, relational, and actionable data collection and analysis to extract deep insights for a wide range of practical uses in a variety of domains. These technologies, together with numerous smartphones apps and a multitude of established social networking, sharing economy, and e-governance platforms, underpin the drive to build the Metaverse. Especially, they have

tremendous potential to produce colossal amounts of fine-grained, indexical data that, by being easily conjoined, shared, and disseminated on a wide scale, become highly appropriate for scrutiny and examination using data-driven and compute-intensive algorithms. However, all ecosystems based on AI, the IoT, and Big Data are growing increasingly complicated, and new data collection methods based on context-aware and distributed computing will exacerbate the effects of these technologies, which will potentially amplify mistrust between them and individual users.

As regards the trend of technology miniaturization, it is the trend to manufacture ever smaller and more powerful electronic, electrical, mechanical, computational, optical, and control devices. Recent innovations in mechatronics, which is enabled by miniaturization, have yielded dramatic reductions in the size of computer devices and systems. Mechatronic devices and systems are associated with various forms of digital instrumentation, digital hyper-connectivity, algorithmization, and platformization with respect to data sensing, data processing, data dissemination, and actuation. Regardless of their size, the core technologies underlying the Metaverse ecosystem application [30] will be equipped with quantum-based processing capacity—when it can be made to do some general meaningful tasks, unlimited memory size, and linked by mammoth bandwidth and limitless wireless connectivity, ushering in the era of always-on virtual environments as the future of the Internet of everything. The main goal of the miniaturization process is to make digital and computing devices more pervasive and ubiquitous, especially sensors and their network node, e.g., the IoT.

The physical and human environment has become strewn with huge quantities of intelligent active measuring and computing devices of many diverse types. This is owing particularly to Micro-Electro-Mechanical Systems (MEMS) and Nano-Electro-Mechanical Systems (NMES), which have been steadily advancing since the 1990s (e.g., Lyshevski 2001 [144]). The in- and on-body nanoscale and remote micro-scale sensors allow for the registering and processing various human parameters without disturbing human actors. This is to be further mediated by immersive devices and advanced immersive analytics. The commonsensical infiltration of miniature devices into people's everyday lives by manipulating objects below micrometers and nanometers is considered instrumental in enhancing the computational understanding of human systems as well as computing systems in terms of analysis, interpretation, reasoning, inference, and decision-making, and thus in improving the system behavior in the physical world through tiny actuators or effectuators. This involves responding "intelligently" to the voiced, facial, gestured, bodily, biological, neural, cognitive, and emotional indications and activities associated with human physiological, biochemical, and psychological states and multimodal communication intents and behaviors [118], in addition to influencing, predicting, and controlling human behaviors. These features are at the heart of both the Metaverse and AmI, which as "crossover approach" overlap in many technological aspects. Indeed, among the enabling technologies of AmI are: nano-sensors and nano-processors, 3-D vision, smart antennas, stratospheric platforms, ultra wide band communications, AR/VR [91], coupled with a number of computer science topics, including, but not limited to [145]:

- Context-aware, situated, affective, sentient, haptic, wearable, calm, mobile, distributed, and location computing;
- Embedded systems;
- Knowledge-based and perceptual user interfaces;
- Machine and deep learning techniques;
- Ontological modelling and reasoning techniques;
- Real-time operation systems;
- Multi-agent software;
- Speech recognition and synthesis;
- Natural language modeling;
- Multimodal communication behaviors and protocols;
- Wireless and mobile communication networks; and

- Embodied conversational agents.

3.2.3. Interoperability, Standardization, Participation, and Join Forces

Since the Metaverse's strength lies in the 3D network of its numerous virtual worlds, interoperability and standardization are regarded as the most crucial features upon which the future of the Metaverse depends in regard to ensuring its smooth operation as a global platform. Thus far, interoperability and standardization are seen as highly uncertain and complex issues [30,55,58]. The former means that users can seamlessly travel between different virtual spaces with the same avatars and digital items and virtual assets, and the latter enables the interoperability of virtual spaces and services across the Metaverse. In particular, the virtual services offered by the Metaverse must piece together to form its 3D network fabric. In the context of MR, the Metaverse can bridge between the unique affordances of VR and AR technologies and the connectivity of social media platforms—if the interplay between these is unleashed creatively [146]. However, the cloud-based approach to avatar physics emulation and graphics rendering computation as a current centralized design is unfavorable, as it currently suffers from several drawbacks caused by the long latency required for cloud access [142]. Moreover, in the shared and connected virtual world in which the digital avatars of people interacting with one another within different virtual environments, the status will be determined by the sophistication of each one's avatar. In order for human avatars to take the correct decision, they need to recognize the action of other avatars and to understand them emotionally and psychologically in both the virtual world and the physical world [30]. This is only one of the many aspects of how humans understand the world, and it already creates, according to Kwon et al. [147], the problem of catastrophic forgetting for AI models on multi-modal data.

In view of the above examples, Meta is intensively working and strongly focusing on building robust interoperability across virtual services for the purpose of heightening the experiences of business partners with respect to their collaboration and efficiency. This is key to the success of the Metaverse—and to the financial gains of big tech companies as well as the power gains of governments. In this respect, the Metaverse includes computer graphics and personalized avatars, less goal-oriented user and social interactions, designs well-suited to VR and AR tools, and links with outside political and economic systems so people can behave according to certain social norms and policy regulations and profit from the so-called virtual goods and services, respectively. However, interoperability means rewriting the current rules and regulations and eroding others in accordance with most of the Internet services—a "brave new world" [148]. On this, Huxley [148] wrote: "The perfect dictatorship would have the appearance of a democracy, but would basically be a prison without walls in which the prisoners would not even dream of escaping. It would essentially be a system of slavery where, through consumption and entertainment, the slaves would love their servitudes". In this light, the issue of interoperability stems from concerns about privacy, cybersecurity trust, surveillance, and control. Regardless, the major big tech and platform companies involved in the Metaverse are working intensively to adopt wholly open source format and, hence, release their control over proprietary ones. The latter are what existing implementations rely primarily on, but several virtual environment standardization projects have been launched in 2021 and 2022 across the ICT industry.

The participation of multi-scale third-party developers will spur demand for different digital products as well as help in producing different products to service community fashions and demands [30]. These developers will further help companies achieve other core attributes, including, in addition to interoperability, persistence, synchronicity, economic feasibility, content and experience, and also offer experience that allow XR and unlimited opportunities of the Metaverse [149]. In addition, the multiplicity of participating players in the building of the Metaverse will help address the financial budgetary needs that will determine success and develop platforms and data exchanges of pertinence in this regard. Third party participation will be key in this digital transformative journey as several have niche expertise in the frontier of the use of avatars via virtual gaming platforms. The

essence of the avatar, in the case of the Metaverse, is noted to align with the aim to build a "Mirror Worlds" (virtual 3D replica of the real world) where users could have a "digital twin", thereby bridging the digital and physical realities and creating unlimited possibilities [60]. However, "Mirror Worlds" [62] is one of the control-freak utopian visions that comprise the Metaverse [4].

In fact, the Metaverse is a rebranding of big tech companies' increasing not only control, but also profit and power. It represents a fusion of these gains for powerful global corporations. Thus, it can be argued that the corporate-driven tech agendas are not made for people as their rhetorical appeals promote or persuasive strategies advance. It has even become clear that the monetary value residing in making the Metaverse is open enough to scale with user and social interaction and to realize huge profits from its deployment. An interest in the idea is simultaneously noted greatly from other big tech companies (e.g., Microsoft, Apple, Magic Leap, and Roblox) by showing a substantial redirection of their resources towards responding to what they perceive as a market change in technological niches. In fact, the idea of the Metaverse is not a new digital platform for big tech companies as Apple has already selected stores or venues where they showcase their products, and Google and Apple use the Apps store where most of their digital products are accessible. The same goes for Microsoft, Epic Games, Nvidia and other major market players. The key question to raise is: Why would these big tech companies overhaul their code and collaborate with Meta to help realize the Metaverse—when they have already put decades and billions into constructing their own? The answer could emanate, to be argued, from the claim that the COVID-19 pandemic offers a gigantic or rare opportunity to reimagine—and reset—the world as strongly advanced by the World Economic Forum. This will most likely lead to substantial shifts in markets and customer behaviors, equating to attractive financial returns in the short and medium term (see Johnson [138] for statistics and facts). This motive is enough to drive big tech companies to combine their products to architect the Metaverse under open-source standards. In fact, for the socio-technical vision of the Metaverse to be realized and delivered and for the concept to be universally accepted and embraced in the real world, concerted efforts and collaborations between big tech companies, governments, and other large corporations are required [60,150]. Especially, the project is complex, multidimensional, extensive, and still new, and also substantive investments of financial, physical, and human resources need to be availed. However, the attracting force of consolidation is pulling the cyberspace together under the auspices of fewer and fewer big tech companies, making them bigger and bigger by swallowing other high-tech companies and thereby merging into a few supermassive corporate powers controlling and taking exclusive possession of the supremely motion of billions of users around the world.

3.3. Societal and Ethical Implications

3.3.1. Social Exclusion and Social Acceptance

The cost aspect of VR headsets and technological products (e.g., Horizon Home, Future of Work, Presence Platform) that will allow people to immerse in the numerous virtual worlds of the Metaverse is seen as a challenge that may create obstacles to its wide acceptance. Johnson [138] provides recent statistics on how much money users would spend on advanced VR gear that would allow them to physically feel what they experience in the Metaverse. In addition, it is highly likely that certain groups of society—based on their education, socio-economic status, age, and disability—will be "locked out", and hence, the Metaverse will continue to perpetuate digital gaps and favoritism that already exist as to the access to existing social media platforms. The accessibility stratification capacity and discrimination in technology use are presently occurring, whereby it is the tech-savvy people that are driving technology adoption. This will not allow for full access for all citizens, especially the non-tech-savvy, the pre-laptop generations, and universal design hindered people. This has always been the case when it comes to the use of new technology, notwithstanding the claim made by Meta about developing young people's

digital literacy programs [57]. This claim applies to smart cities as well. The extensive use of ICT poses the risk of deepening inequalities and social divisions, as it may isolate "the unskilled and IT illiterate sections of the local poorer population" ([151], p. 312) inside cities [152] and between and within cities [151]. The key question is whether the digital divide might become a Metaverse divide in the so-called virtual/augmented cities. This could be beneficial to those groups of society that exhibit negative feelings and attitudes towards the Metaverse, nevertheless. This is justified by the significant social problems across populations caused by the widespread adoption of social media platforms [31]. This brings us to the question of whether the Metaverse will be widely accepted among people, which is difficult to predict as people do not accept everything that is technologically feasible and promoted as a new experience.

Indeed, it is unlikely that the Metaverse will appeal to all groups of society—certainly not in the same way or at the same time. This is due to the unequal distribution of socio-economic benefits and risks in society, adding to personal preferences and beliefs. In relation to the social acceptability of the Metaverse, Lee et al. [30] discuss a number of influencing design factors, including fairness, cyberbullying, device acceptability, avatar acceptability, and privacy threats, and argue that these will determine the sustainability of the Metaverse. In particular, as argued by Gurov and Konkova [29], it is necessary to adopt a new socio-humanitarian rationality in the design of the Metaverse. Similarly, humanistic concerns of design were determining in the vision of AmI (see Bibri [118] for a detailed discussion of the seminal role of participative and humanistic design for the sustainability of AmI). A holistic view considering people and other non-technical factors were of crucial importance to the realization of AmI [95]. As a consequence, the vision of AmI continues to be reconstructed around new concepts, ideas, and problems to solve [153], and R&D has shifted its focus toward the design of practical win-win solutions [89].

Furthermore, the Metaverse is most likely to create new concerns that could potentially affect the universal access to and use of its products, services, and devices, or cause people to reject it if new skills and competencies become required and result in different degrees of acceptance. According to recent statistics published by Johnson [138], increasing technological literacy and skills as one of the benefits of the Metaverse worldwide in 2021 was only 34%. This proportion also reveals that there still is a quite large number of people that will not benefit from the Metaverse, including those that will lack the skills and competencies needed to use it as a complex platform compared to existing social media platforms. This is consistent with conclusions from the previous research work carried out on the vision of AmI [90]. In addition, the feelings towards the Metaverse according to adults in the United States as of January 2022 are: curious—33%, uninterested—27, suspicious—23%, concerned—19%, indifferent—19, excited—18, optimistic—16, confused—12% and none of these—7% [138]. So, the negative feelings tend to dominate over the positive ones. This could be explained by the awareness this group of society has gained regarding the use of social media platforms over the past two decades. Consequently, this group of society does not seem to be expressing any desire for the extraordinary in service encounters in the virtual world, which may not help promote what is envisioned (claimed) to be desirable, pleasant, and entertaining to certain groups of society in the short term. One of these groups is the youth who currently seems to show curiosity as well as enthusiasm about the Metaverse, with unpredictable outcomes in the medium term. Regardless, the Metaverse should reveal at least what the so-called post-reality universe has to offer in order to motivate more users to relate the available possibilities to their actual needs, dreams, and wishes. In fact, despite the following benefits of the Metaverse worldwide [138], the social trends towards the future of the Internet are still not universal, and this will undoubtedly continue in this direction:

Overcoming obstacles—39%
Enhancing creativity and imagination—37%
Traveling the world without moving—37%
Connecting with new peoples without feeling awkward—34%

Creating completely new job opportunities—30%
Meeting your loved ones whenever you want—30%
More possibilities in education—29%
Giving opportunities for self-expression—27%

Indeed, looking closely at the proportion of these claimed benefits being all under 40%, it is clear that more people are obviously inclined to do and experience things in real-world settings, despite the claim that the Metaverse will overcome many barriers that hinder physical social interactions, predicated on the assumption that people will have the ability to represent themselves in the form of avatars in the cyberspace. Avatars can experience heterogeneous activities in real-time, characterized by unlimited numbers of concurrent users (theoretically) in multiple virtual worlds [30,154]. However, the virtual visibility (and hence material invisibility) in the Metaverse as a set of technological artefacts may well rather harm than facilitate its social acceptance due to the fact that these artifacts are untouchable and thus become uncontrollable. According to Heidegger [155], the "present-at-handness" and the "ready-to-handness" of a tool do not exclude each other and are situated. Thus, the process of active acceptance of the Metaverse is presented as a struggle between the user and the virtual space, where the user aims to gain control or ascribe meaning to virtual artefacts. Therefore, it is not necessarily harmonious or linear, as technologies are ultimately "domesticated when they are 'taken for granted,' when they reach a state of mind of being a 'natural' part of everyday life. As such, they are not anymore perceived as…machines, but rather as an almost natural extension of the self" ([90], p. 35). The way human users are pre-configured by the computer designer in the Metaverse does not necessarily mean that virtual spaces will be used as intended in real-world settings. This relates to the adoption of innovation, i.e., accepted by individuals on a micro-level, versus the diffusion of innovation, accepted in a specific social system on a macro-level. Constructivist approaches [156,157] to the study of S&T have criticised the diffusion of innovation due to not only its deterministic view, but also its behaviorist, linear, and overtly rationalistic conceptions.

3.3.2. Privacy, Security, and Trust

At the heart of the economic and social logic of surveillance capitalism, which undergirds platform society and thus platform urbanism, is control, and concerns about privacy is part of a larger concern about people having control over their own lives. Platform society, where platforms have penetrated the core of urban societies, is witnessing drastic shifts in civic and public practices and ethical and democratic norms. The responsibility of "anchoring public values and the common good in a platform society", including privacy, security, and safety, as well as fairness, control, and accountability [158] is increasingly being outsourced to the global technology sector. Surveillance is at the heart of the Metaverse as a process of platformization in terms of its data infrastructures and governance frameworks. Bibri and Allam [27] examine the forms, practices, and ethics of the Metaverse as a virtual form of data-driven smart cities, focusing on privacy, dataveillance, and geosurveillance, among others. The authors highlight the ethical implications the Metaverse will have on the experience of everyday life in post-pandemic urban society. They argue that the Metaverse will do more harm than good to human users due to the massive misuse of the hyper-connectivity, datafication, algorithmization, and platformization underlying the global architecture of the computer mediation upon which surveillance capitalism depends.

Privacy threats are worrying most of the users and consumers of the Metaverse, as the privacy-enhancing mechanisms proposed thus far remain inadequate to solve this ethical conundrum. Thus, privacy is a real challenge and quandary facing the Metaverse [10,28,30,159–161], especially in relation to edge computing and facial recognition. Not only the issue of privacy but also the issues of cybersecurity, cyberattacks, trust, and accountability have long been, and continue to be, a subject of much debate and an area of intensive research [30,162–169]. Based on recent statistics published by Johnson [138], among the concerns posed by the Metaverse are, in addition to privacy, hacking, trust, data abuse, and identity protection. Lee et al. [30]

provide a detailed discussion on privacy, security, trust, and accountability in the context of the Metaverse. While much of ongoing debate revolve around acceptable practices in regard to accessing and disclosing personal and sensitive information about people, the era of Artificial Intelligence of Things (AIoT) marks the end of privacy. One implication of this is that, as no data on individual users can be directly collected, Meta will have "no obligation under current privacy regimes to give notice to, or gather consent from customers in the same way that direct collection protocols require" ([170], p. 98).

Additionally, it is expected that the deceptive abuses of the Metaverse will be significantly amplified because of the underlying immersive technologies being specifically designed to fool the senses and to keep users unaware of the moral implications of deceptive methods [26,31]. What is risky to the users of the Metaverse is that this platform will be steered and controlled by big tech companies and what this entails in terms of the aggressive tactics and engagement strategies being currently used in social media platforms. Indeed, the risks to the users of the Metaverse "are not solved by establishing strong industry norms among platform providers or by enacting major changes in platform business models" ([31], p. 7). To further complicate matters, in the wake of the COVID-19 pandemic, many countries have enacted policies to govern data processes to serve efficiency and effectiveness at the expense of privacy as a result of the accelerated rollout of digital technologies. Bibri, Allam and Krogstie [10] provide a further discussion of data privacy and data governance in the context of the Metaverse. With respect to the legal conundrums of the Metaverse, Kasiyanto and Kilinc [137] elaborate property law, intellectual property law, contract law, "virtual property law", monetary and payment systems laws, regulation of virtual assets, tax law, and criminal law, among others.

3.3.3. Data-Driven Corporate-Led Technocratic Governance and De-Democratization

At the core of the Metaverse as a global platform is data-driven corporate-led technocratic governance. Bibri and Allam [26] explore and question the Metaverse as a virtual form of data-driven smart urbanism through the prism of the logic of surveillance capitalism, focusing on how and why the practices of the governance of urban society are bound to be undemocratic and unethical. The authors provide useful insights into understanding the concerns about the Future of the Internet in the context of STS. Related to technocracy, governance concerns are due to the pervasive and massive use of new technologies, such as Big Data, the IoT, and AI in smart cities. These technologies promote technocratic modes of urban governance, raising a range of issues related to power and control [117,171,172] due to the continuous surveillance and monitoring of urban environments. This undermines civil liberties and democracy [171,173,174]. Urban affairs are framed in socio-political configurations of technocratic regimes and constituted in social constructions of big data systems as an apolitical or neutral matter, an illusion of political neutrality and objective view of smart technologies [96,175]. In this regressive return to a modernist rationalism, where a "no alternatives" scenario is suggested by post-political dimension of smartness [176], democracy is subordinated to the governmental and corporate elites who control smart technologies and govern "by code" ([96], p. 315). Outsourcing democratic resilience increase the power of the powerful elites, raising further concerns over accountability, representation, and transparency. As "a two-stage process where democracies avoid democratic declines altogether or avert democratic breakdown…, democratic resilience has become substantially weaker…and substantial declines in democratic practices have occurred since the 1990s, leading to the unprecedented breakdown of democratic regimes" ([177], p. 1).

Although the data-driven smart model for urban development contributes to sustainability dimensions [178,179], it entrenches the idea that there are "no alternatives" to the techno-managerialist mode of urban governance [117] by being promoted as optimizing and enhancing urban management through "standardized decision-making" processes [176]. These prioritize efficiency over political action, which is seen as impediment [102]. In data-driven governance, citizens play a "subaltern role" [117] and there is no real democratic participation [171,180]. Data-driven smart city systems "are defined through a digital

consumer experience that has inherent biases and leaves parts of the city and its population unaccounted for. This renders the city less resilient in the face of future social. . . risks" [181]. The global architecture of computer mediation undergirding surveillance capitalism "produces a distributed and largely uncontested new expression of power. . . It is constituted by unexpected and often illegible mechanisms of extraction, commodification, and control that effectively exile persons from their own behavior while producing new markets of behavioral prediction and modification" ([182], p. 1).

Furthermore, routinizing new forms of social sorting based on surveillance technologies has "the potential to permanently shift the nature of governmentality and to act as a pathway towards authoritarian forms of governance where technology is used to actively impose the will of the state onto citizens" ([19], p. 371). Numerous investigations have demonstrated that the state has a poor record when it comes to practicing dataveillance [183] and geosurveillance, which lend a legitimacy to authoritarianism concerns. Dataveillance and geosurveillance in the Metaverse will exacerbate as to harvesting and exploiting the data that are collected for other purposes than what users wish for by means of connecting numerous virtual settings and virtual services. The Metaverse as a techno-urban utopia is built on the monitoring of citizens and places through extensive networks of data collection, processed and analyzed via AI algorithms and mathematical models. Arguably, mathematics presents an answer to a set of pre-defined variables, which is the reason why it appears "rational", the algorithmic rules are made up to get a certain outcome. Regardless, in data-driven smart cities, technocratic governance replaces democratic policy-making and politics and AI systems replace wider urban knowledge and expertise [96,184]. Urban life is far more than digital imprisonment and computational ordering. At the heart of the Metaverse is a computational understanding of human users' cognition, emotion, motivation, and behavior that reduces the experience of everyday life to logic and calculative rules and procedures [27]. This implies that human users become more knowable and manageable and their behavior more predictable and controllable, and thereby serve as passive data points that feed the AI and analytics systems they have no interchange with or influence on. A rapidly growing body of the social scientific literature is critically exploring how techno-urban imaginaries epitomize the "colonizing of futures" by corporate-led technocratic ways of governing and knowing [102] by means of algorithmic codes.

In addition, in the Metaverse, the human users that are supposed to live in virtually inhabitable cities are not asked for their views on the meanings of social life there as to whether it is desirable and on the kind of virtual services they benefit from, nor are they given informed choices to opt in or out as a self-motivated and self-determined human behavior. Human users ought to have a stake in constructing the meanings and sharing the understandings of social life and social order forms in order for them to find a place for the Metaverse in their everyday life. Indeed, they are active shapers of their own reality—not passive adopters of technological artefacts and consumers of virtual services. Otherwise, there will be implications of enforcing changes to the world that do not correspond to the aspirations of people who are affected by the kind of social transformation that is being dictated by the Metaverse. It is the vision of technologists, designers, and producers that seem to dictate what forms of social life and social order will prevail and what kind of virtual services will be provided. In a large part of the promotional material of the Metaverse, applications contain no humans but avatars and devices, which contradicts the idea of putting the user at the center of technology design. Lee et al. (2021) [30] provide a focused discussion on design issues related to the Metaverse. However, there is a growing mistrust, criticism, and skepticism of the idea of the Metaverse and the function of its enabling computing and immersive technologies in harvesting and digesting colossal amounts of data to control, regulate, and guide people in directions desired by corporate and governmental elites.

3.3.4. Hive Mentality and Cyber-Utopianism

Democratic processes and spaces should be of high importance with respect to the guidelines and principles that will be applied in the Metaverse to govern the behaviors of users in the virtual world. Especially, the Metaverse is expected to have its separate governing rules [30], which will be underpinned by the logic of surveillance capitalism it embodies [26]. Zuboff [185] argues that the political foundation of self-determination is challenged by "dispossession by surveillance", as it concentrates rights in the surveillance regime of capitalists and elites. While the Internet has ushered in a major shift in society, with significantly positive effects, there are still deeply negative effects to be aware of. These have been addressed in more detail by Andrew Keen [186] who traces the technological and economic origins of the Internet, including the rise of big tech companies and the increasing commodification and monetization of social action and human activity, showing it all in terms of what the Internet is doing to our society and the unforeseen consequences of unpleasant aftershocks. More relevantly, Keen [186] warns against the risks of mob mentality that dominates the Internet, which empowers the rule of the mob rather than support more democratic processes and thus freedoms. This is expected to exacerbate in the Metaverse, as the world shifts from social media to immersive media and new deceptive methods will be used based on opaque and largely invisible algorithms. One implication of this is that users might adopt behaviors based on the circle of influence exerted by the Metaverse and the agenda-driven corporate media through misinformation and mass formation psychosis. These conditions usually affect the human mind in ways that cause people to lose contact with reality and thus become unable to fully distinguish what is real from what is not, exhibiting disturbed thoughts and perceptions due to the mob influence that is facilitated by the existing social media platforms owned by Meta. Accordingly, the Metaverse may create obstacles to critical thinking. One form this may take is suppressing or prohibiting news, posts, discussions, forums, videos, films, and others that are deemed politically unacceptable by mobilizing powerful algorithms and recommender systems for the purpose. It is widely recognized that content moderation shapes social norms and has consequences for the fabric of society and cultural production. AI-based techniques are more likely to be directed towards altering the opinions, views, and beliefs of people by those around them to fit the virtual communities they are in. Indeed, the disorderly, unruly, and emotionally charged mob evoke more often than not the same kind of reaction in a substantial number of people who become negatively affected by neglecting their own feelings and adopting the behaviors of their peers on the Internet. The hive mentality may further be fueled by the rampant censorship, the incessant push for the political rhetoric, as well as the total control over the narrative advanced by the ruling elites, thereby creating a society that is dependent on the dominant channels of communication and interaction and on the hierarchy of the establishment. Cyber skeptics have long argued for the idea that censorship allows repressive governments to use technology against dissenting movements [187].

The Metaverse may lead to what some novelists refer to as a cyber-dystopian world where societies could sacrifice humanity to the cult of *cyber-utopianism*. This concept denotes "an apocalypse of self-abdication" [188], i.e., the denial of one's own interests in favor of those of others. Lanier [188] notes that "consciousness is attempting to will itself out of existence", warning about de-emphasizing individuality, i.e., the unique characteristics and traits that make each person, by emphasizing collective consciousness. The author points out another extreme claim promoted in the digital era: that humans are, compared to bits which are presented as alive, perceived as transient fragments. Growing at the expense of individuality, the digital hive entails that science is no longer seeking "theories that scientists can understand, because the digital cloud will understand them better anyway. The antihuman approach to computation is one of the most baseless ideas in human history" [188]. This raises two related questions: To what extent have speculative fiction narratives been embraced by big tech companies as certainties and what kind of implications will this embrace have on humanity. However, digital dystopias concern

themselves with the unforeseen negative effects caused by new technologies, which reflect and encourage the worst aspects of human nature [187]. In a nutshell, digital dystopias envision societies made worse by advances in S&T [189].

There has been a strong tendency to eliminate the rugged individualism that has built the Western culture, where people are in control of their destiny, they know what is best for themselves, and have the freedom to act on that wish. The rugged individualism emphasizes personal liberty, independence, self-reliance, resourcefulness, self-direction, and free competition in social and economic relations—from outside governments. The ultimate goal is to achieve the collective hive consciousness that can be controlled and forced to comply through psychological operations of fear and control. The fascist global state is now on public display as a result of a substantial number of people being manipulated to live in constant fear of economic crises, wars, and pandemics while sacrificing individual freedoms for safety and giving up privacy for convenience—with their perceptions and behaviors having molded slowly through a myriad of machines. This sacrifice to surveillance technologies is "part of the imposition of totalitarian social controls" as stressed by social scientific literature [102]. This in turn mean wiping out the last vestiges of personal autonomy, abolishing individual and national sovereignty, and jeopardizing its integration. This is intended to disable the constituents pooling sovereignty to preserve and enlarge it and to weaken them and their political and institutional mechanisms by dividing them against external pressures and discouraging them from finding common interests and promoting their national interests through otherwise mutual cooperation. The practice of platformization and its acceleration and normalization by platform capitalism is increasingly facilitating the collective hive consciousness. From a critical political economy perspective, platformization involves "the intensification of global platform power and governance" [99]. Critical political economists have drawn attention to issues of surveillance and imperialism [190]. Platforms, which are not politically neutral [191], amplify the power of big tech companies that control them, creating new potentials for discipline and surveillance through the technocratic and algorithmic nature of technologies towards capture and control. Surveillance capitalism is best described "as a coup from above, not an overthrow of the state but rather an overthrow of the people's sovereignty and a prominent force in the perilous drift towards democratic de-consolidation that now threatens Western liberal democracies" [192]. Overall, the main tenet of the new tech culture, where the ideas that were once kept in a secure place or out of sight in the obscure world of AI labs, is that all of social reality is but one big data system [188].

During the 1990s, there was a belief that cyber-utopianism could bring about a more decentralized and democratic society [193] in which freedom of expression and access to culture are perceived as ideal values. On this note, Fuchs [194] suggests that utopian-communist stories can inspire contemporary political imagination and socialist consciousness in terms of a utopian Internet and the organization of digital socialist society. However, this belief, which prevailed during the inception of the Internet, among other major utopian views of the cyberspace, has been diminished. A critique of the role of cyber-utopianism in global politics [195] states that this belief enables the opportunity for authoritarian control [196] through constant surveillance and monitoring. Central to the imposition of authoritarianism is the sacrifice of civil liberties related to privacy and democracy to surveillance technologies. Cyber dystopias portray future societies in which digital technologies and data-intensive techniques cause major social disruptions [197,198]. They comprise dominating new technologies and social media platforms, and represent the narrative of the role of advances in S&T in shaping social, cultural, and political structures [199]. They portray future worlds where people lose control over their lives, experience awful mental and social conditions, and become dependent and unable to stop undesirable change due to scientific and technological advancements. As a consequence, people in dystopias may live in fearful and repressive states due to invasive technologies, leading to an Orwellian situation. That is, after Orwell [200], further brutal policy of draconian control by surveillance, disinformation, and propaganda as practiced by repressive governments.

While surveillance technologies may be useful for tackling pandemics, people should accept the surveillance system to the extent that governments reassure that it is abolished once pandemics end. However, this is not what cyber dystopias warned us about. In point of fact, the surveillance system deployed to tackle the COVID-19 pandemic will become part of the "new normal" in monitoring and governing societies—and hence will not be turned off after the crisis [201]. What remains to be done is to "shift the domain of the intended surveillance just enough to feed the ongoing process of people getting used to these controls and forgetting the embarrassment of being permanently monitored, in other words—having no off–switch" ([88], p. 220). Indeed, cyber dystopias portray future worlds where people are controlled by constant surveillance and stripped away from their basic rights and liberties and live in extreme conditions of deprivation due to new forms of social control, psychological manipulation, enslavement, and deepened social inequality. The end point of surveillance capitalism is a form of social life and social order that can only be totalitarian, notwithstanding the future images presented by big tech companies as a new era of transparency, accountability, and freedom. All things considered, the promise of a better life made in the Metaverse "could become an apocalyptic trip of an automatic 'repression to normality,' without the option of creative adventures or explorations" [88].

3.3.5. Techno-Utopianism as Dystopianism

Techno-utopianism denotes any system of beliefs and values that is based on the premise that advances in S&T will eventually realize a utopian ideal or a perfect society in the near future. In this hypothetical society, the functions of government, laws, and social conditions are solely directed towards the well-being of all citizens—collective benefits. Critics of techno-utopianism point out that it tends to dismiss the positive outcomes of laws while focusing on government interference and intrusion in the private life and freedom of citizens. The critique of fictional representations and socio-technical imaginaries of future worlds as techno-utopias invokes long-standing cultural fears about the impacts of advances in S&T on society. This has generated a wide range of images of future worlds that tend decisively towards dystopian societies and cities [100,200,202,203]. Both fictional representations and socio-technical imaginaries of future worlds warn against risks or convey warning signals (e.g., social inequality, social sorting, surveillance, control, dehumanisation, authoritarian regimes) that might accompany scientific and technological advances [32,69,70,204]. STS scholarship has evoked the prevailing strands of anti-utopianism in terms of utopian desired views of future worlds resulting inexorably in dystopian outcomes. Social scientific critique of the techno-utopianism of the socio-technical imaginaries of data-driven smart cities can be deepened through engaging with speculative fiction [102] as an alternative to futures thinking approaches [205], which are associated with fictional representations of dystopian cities [100,202]. These are frequently marked by an obsession with maintaining an oppressive order, and the future urban worlds imagined in speculative fiction are characterized by "the dystopian consequences of elite rule through advanced technology and the imposition of a strictly rational and controlled social order" [102]. The hegemonic ideologies imposed by authoritarian states or tyrannical governments seek to produce bodies that are docile, submissive, conformed enough to comply with orders that further allow power over societies to be sustained. Technologies seek to produce compliant bodies [206]. Orwell [200], whose work is characterized by opposition to totalitarianism, wrote: "all tyrannies rule through fraud and force, but once the fraud is exposed, they must rely exclusively on force". The dystopian rulers are brutal and fanatic [207]. Dystopian novelists portray futuristic imaginary societies in cataclysmic collapse—with devastation, oppression, desperation, reset, control, and elites who claim to battle the environmental ruin and social decay of the world. Extreme events and impermanent realities are characteristic of dystopian societies where nothing is as stable and secure as one might think—unexperienced socio-political realities. The COVID-19 pandemic has demonstrated that the dystopian world is not far from reality. It has become almost impossible not to draw a connection between the dystopian world portrayed in speculative/science fiction and the

draconian measures that have been implemented by a number of tyrannical governments in the once labelled democratic societies. Here, psychological, ethical, social, cultural, and socio-economic factors have become invisible and less acknowledged—if not completely ignored in certain parts of the world.

The argument that smart urbanism is a false dawn rather than a utopian vision [8] pertains, by extension, to the Metaverse which is too flawed [26,27,31] to incarnate techno-utopianism. This refers to a futuristic society in which living standards become ideal as a result of scientific and technological advances due to their potential to solve every possible problem. Smart urbanism—is about rebuilding cities through integrating digital technologies with spatial forms and networked infrastructures, which is "being represented as a unique emerging 'solution' to the majority of problems faced by cities today" [8]. It is about the strategic use of networked infrastructure and big data technologies to create smart forms of living, mobility, environments, people, economy, and government [208]. With respect to the Metaverse as a virtual form of data-driven smart urbanism, the physical world will, however, be enmeshed with the digital world in much deeper, complex, and intricate ways due to the technical features of immersive technologies. This may lead to what is called a utopian dystopia. While technology in techno-utopianism is believed to be for the greater good, it can also be used negatively or wickedly to inflict harm to people, i.e., techno-dystopianism.

A purely dystopian reading of the socio-technical imaginaries of data-driven smart cities risks reproducing what Baeten ([204], p. 148) identifies as "political mediocrity" which "ails to crystalize in a convincing political project that would provide a credible alternative for the poverty-generating capitalist shaping of today's city". Fictional representations of future worlds convey warning signals opposed to what they claim about places of ideal perfection in terms of social conditions, justice, laws, and wellness. These epitomise utopias as ideal worlds—with minimal deprivation, injustice, crime, violence, and ill-being. As utopias and dystopias are intimately connected, many dystopian scenarios are present in utopian scenarios and vice versa, the Metaverse could turn into a dystopia in which human conditions become extremely awful and destructive to well-being given the kind of flaws, agendas, and pitfalls cloaked in the envisioned scenarios of the empyrean cyberspace. The dystopian concerns associated with utopian changes lie in that utopian desires are themselves inherently flawed, leading towards "the imposition of totalitarian blueprints" instead of emancipation [102]. Huxley [148] anticipated huge scientific advancements in different psychological techniques that are combined to create a dystopian society, where people are classified into groups based on wealth, political power, social power, income, occupation, education, gender, ethnicity, and social status. In point of fact, the convergence of and innovation in dominating digital and computing technologies is transforming the processes involved in social sorting, individual selection, decision-making, and democracy—not for the better—with respect to the ways in which large-scale practices of surveillance and monitoring facilitate profiling users and screening social groups in digital urban societies. Dystopias portray surveillance societies with unlimited control and dictatorship—absolute power concentrated in the hands of a ruler. We can see a parallel nowadays that exists in contemporary societies as to the massive use of invasive technologies by many governments to interfere and limit the private life and freedom of citizens [209]. It follows to argue that the COVID-19 pandemic is not about health and safety, it is about mass compliance and control towards a dystopian world.

4. Discussion

The study has shown that the Metaverse is discursively constructed and materially produced by socially anchored practices and institutionalized structures. This view maintains that knowledge and understanding of S&T are socially mediated and historically situated processes. As a form of scientific knowledge and scientific activity, the Metaverse is shaped by—and also shape—social, political, and economic structures. Further, the study has corroborated that the success, expansion, and evolution of the Metaverse stems from

the transformational power of S&T and its legitimation capacity, as well as the performative power of the socio-technical imaginaries of data-driven smart cities. In this view, the Metaverse has negative implications for social and ethical values.

The findings are in line with the theoretical perspective of sociology of scientific knowledge, which is concerned with "the social conditions and effects of science and. . . the social structures and processes of scientific activity" [210]. This relates to the theory of CDA in that the Metaverse as a scholarly (social scientific) discourse is inherently part of and influenced by societal structures and hence produced through social practice and within social interaction processes [211]. Moreover, the findings are consistent with the social studies of science in that the wider social and material context shape scientific knowledge and related system of production [212,213]. They also adhere to the theory of FDA in terms of the dialectic relationship between social structures and discursive practices [43,214]. With respect to the finding related to the rationale behind the success, expansion, and evolution of the Metaverse, it is supported by the theory of discourse in that the scientific discourse has authority as regards decision-making, policy-making, and knowledge production [43], as well as by the interdisciplinary theories of the STS in that scientific knowledge plays an important role in politics, policy, and S&T regulation. Bibri and Krogstie [46] provide a discussion on this relationship as well as the legitimation capacity of S&T with regard to decision-making, policy-making, and knowledge productions.

Regarding the concerns raised by the Metaverse over the risks and impacts of its underlying technologies, the findings are consistent with the philosophical assumptions of STS in that S&T give rise to controversies, which in turn justifies questioning and challenging the value-neutrality of S&T and the ethics of their imperatives. Huesemann and Huesemann [215] demonstrate why the negative consequences of S&T are inherently unpredictable and unavoidable, modern technology in relation to economic growth hastens collapse, and counter-technologies do not offer long-lasting solutions. Therefore, scientific knowledge ought not to be superior of other forms of knowledge [43]. Additionally, drawing on the constructivist insights of STS, there is a strong need for political engagement in matters of techno-science: "scientific production as a co-production process—social and epistemic, cognitive and material, cultural and natural, human and non-human" [216]. Such engagement entails much greater democratic participation of the public in the techno-scientific decision-making process, as well as a larger role for STS scholars whose insights might contribute normatively to the civic enhancement of modern techno-scientific culture [217,218]. Indeed, based on theories from the social shaping of technology (SST), the technology and society should evolve in a mutual shaping process by way of cultures, politics, and economics. Central to the social shaping of the Metaverse is the idea that choices, which are not necessarily conscious, are inherent in the development of its technological systems and in the trajectory of its innovation processes. The latter are often associated with overlooking user and social dynamics due to a simplistic view—rather than a predetermined logic, resulting in the linearity of innovation as well as technological determinism—which rests on the idea that technology follows its own developmental path and shapes society. The garden of forking or multiplicity of paths characterizing the innovation process potentially leads to different outcomes and differing societal implications.

Due to the worldwide attention it has generated, coupled with the wide prevalence and acceptance of its predecessor social media platforms, the Metaverse may evolve from a vision to an achievable computing platform—at least for certain groups of society. However, the realization of the Metaverse as a particular vision of the Future of the Internet remains uncertain, and much of it will unfold in unpredictable ways. To put it differently, while the Metaverse may come closer to realization—though different from how it is currently envisioned, it will be difficult to bring it into an effective action—wide deployment. One of the underlying assumptions in this regard, based on futures studies, is that rationally predicting the future entails recognizing that many different futures are possible, and that the future is far from being determined with absolute certainty.

Although the Metaverse has the potential to interlock, subsume, and afford presence with others and to easily funnel users from one digital space to another—provided that the issues of interoperability and standardization will be dealt with, it is not a universal experience yet. Furthermore, the claims and promises made in the envisioned scenarios of the Metaverse are rather unrealistic and optimistic, to say the least. This is not new and is, in fact, typical to not only fictional representations of future worlds, but also socio-technical imaginaries. The rapidly growing body of social scientific literature is exploring how the utopian and fictional fantasies of partially renovated or wholly transformed cities have little to do with contemporary urban societies and realities, as well as ignore the risks of technological determinism embodied in future worlds [96–98,117,122,219]. This literature critically questions the promises and claims made by the advocates of the socio-technical imaginaries of data-driven smart cities and the urban worlds they construct. By their definition, socio-technical visions promise a better world without really providing a strategic roadmap towards turning it into reality or achieving that goal, thereby their rhetorical orientation or inclination. At present, the narratives of the future worlds described in the discourse of the Metaverse are struggling to secure coherence and continuity. Thus far, this discourse delivers hopes and dreams rather than practicalities and truths. While there is no intention to make judgments about the divination of the desired (utopian) views of the virtual life-worlds enunciated in the socio-technical vision of the Metaverse, Meta will—as with the creators of AmI and the other preceding socio-technical visions—continue to evangelize the vision and thus overstate such views to the extent that reflects mere unrealism as a way to make it come true.

In view of the above, it is likely that no breakthrough will be perceived in research and practice due to several reasons. One of which is the skepticism surrounding the timing of the launch of the Metaverse project—during the height of the COVID-19 pandemic. In other words, the Metaverse did not emerge from a real crisis—but rather a crisis that is argued to be intended to normalize and cement the digital transformation of urban society and the practice of surveillance capitalism for tighter forms of governance. This implies eroding civil liberties and thus undermining democracy and privacy [17,19,21,26,27,201]. As such, this crisis serves as a path-shaping moment for instigating unwelcome or undesirable urban changes. In addition, the technical and computational challenges associated with the development of the Metaverse are enormous [30,58,132] and need to be addressed and overcome prior to its realization, not to mention the ethical, social, and legal challenges. Moreover, there is a ton of caveats and qualifiers which concern the realization of the Metaverse. Critics argue that the worst may happen from the Metaverse—just like AmI [93], while advocates claim that Meta is working to solve problems during the development stage to prevent the worst from happening. Furthermore, the single socio-technical vision driving the Metaverse R&D poses significant risks that may create stumbling blocks to bringing it closer to realization. Rather, the Metaverse should converge on multiple visions of the Future of the Internet instead of a single vision of the virtual worlds it imagines. It is important to not exclude alternative visions in the evolution of the Internet. Otherwise, there might be a great risk that the vision might not actualize—just like AmI. The Metaverse should not get stuck to a single vision of the future, and there is a need for diverse and plural representations and imaginaries of future urban worlds. While the idea that digital and computing technologies will be in the scenarios of the everyday lives of people has become a reality and caused social disruptions, it is important to acknowledge that the virtual worlds portrayed by the Metaverse may well go in different directions from what is currently projected. Regardless, as with every new socially disruptive technology, it takes time to fully understand the implications of the Metaverse. So, there is a long way to go, at least one decade, to really comprehend what the Metaverse all means, or to have a complete insight into all of its complexities—and hence vulnerabilities—and negatives and positives. This is further compounded by the lack of the theoretical basis and empirical evidence required to holistically assess the risks and opportunities of the transformative processes of the Metaverse. All in all, the uncertainty surrounding the realization of the

Metaverse is due to a plethora of challenges and open issues, which have proven to be very difficult to solve—based on the lessons learned from previous technological forecasting and social change studies.

On an optimistic note, in order for the Metaverse to go beyond the recurring unilateral claims of the preceding socio-technical visions, not least for the youth age group, its user, ethical, social, cultural, and political implications should be made more explicit. In other words, the Metaverse should search for alternative directions and go behind the recurring one-sided claim of togetherness, connectedness, interconnectedness, free-flowing information, and a happier and more pleasant world—as the case for all the preceding consumer technologies. More importantly, it needs to adopt a more holistic approach in order to possibly bring the vision closer to realization and delivery and to respond to the real needs and desires of people. This implies that investments in the Metaverse as part of scientific and technological development should be justified by societal and ethical concerns rather than global competitiveness and technological advancement. A perspective of balanced development necessitates balancing concern across social, economic, and cultural dimensions; formulating and negotiating choices and decisions based on an open and participatory process; adopting an open approach towards disruptive innovations within existing networks of stakeholders; favouring innovation and development as to evolving societal challenges and opportunities pertaining to transformative effects [118].

Overall, just like all the preceding socio-technical visions, the Metaverse is affected by political practice in relation to advances in S&T, pandemics, economic crises, governance shifts, as well as knowledge/power, i.e., knowledge produced by a system of procedures to fulfil a strategic function, established in Western society. Both of these factors will determine the success and evolution of the Metaverse. From a philosophical perspective, the Metaverse can be seen as a discourse of using computational approaches and inquiries that historically becomes fashionable and also quickly disappears as situated in experience. "All knowledge about reality begins with experience and terminates in it" ([220], p. 164). As a current hegemonic discourse, the Metaverse "is constructed in the light of culturally specific, historically contingent, and episteme conditioned conceptions about the social, political, institutional, economic, and technological changes" ([221], p. 1). As asserted by Foucault [43], it is the pre-cognitive space of knowledge—where configurations are grounded in a set of claims, assumptions, premises, values, and truths basic to how the whole culture decides and justifies what is certain of—that determines "on what historical a priori, and in the element of what positivity, ideas could appear, sciences be established, experience be reflected in philosophies, rationalities be formed, only, perhaps, to dissolve and vanish soon afterwards" ([222], pp. 21–22). With respect to positivity, the idea of the Metaverse is already facing harsh criticism and raising much controversy and contention.

As regards the limitations of this study, given their interdisciplinary and transdisciplinary nature, S&T studies are associated with shortcomings as to rational analytic methods in characterizing and understanding complex phenomena. Another polemical aspect of STS relates to the difficulty in theorizing about contextualization in terms of the socially constructed nature of S&T, as much of scientific work holds tightly to the objective nature of scientific knowledge based largely on empirical evidence as a special way of knowing. The epistemological nature of scientific knowledge as socio-culturally, politico-institutionally, and historically embedded—supported by relativist-oriented historians, philosophers, and sociologists [43,50,210,212,213]—has been argued against by a number of scholars [223–225]. Nonetheless, the public concerns relating to the hyper-connectivity, datafication, algorithmization, and platformization of urban society has led to a wide critique of the idea of techno-scientific progress associated with the Metaverse and data-driven smart cities, especially in relation to the ethics and values of society. STS reflects a widening public engagement with techno-scientific concerns, and STS scholars, irrespective of their approaches and motivations, value the constructivist and contextualized nature of S&T in modern society. However, other weaknesses of the study pertain to the qualitative methods applied in STS, particularly discourse analysis, namely the lack of verifying the obtained

results, the difficulty in investigating causal relationships, the subjectivity surrounding the quality of the data gathered, the reliance on the experience of the researcher, and the difficulty of replicating the results. Moreover, it is difficult to select the most suitable method for the setting of the study out of the available discourse analysis approaches. And these do not provide answers based on scientific research.

5. Conclusions: Findings, Future Research Avenues, and Contributions

Scientific and technological advances give rise to both socio-technical imaginaries that project visions of desirable futures, animated by shared understandings of forms of social reality, as well as fictional representations that warn against risks and imagine future possibilities, which in turn provide alternative views on how the future can be understood and framed. Fictional representations play a role in shaping alternatives to socio-technical imaginaries The Metaverse is a set of fictional presentations of future urban worlds that are constructed as a virtual form of the socio-technical imaginaries of data-driven smart cities, where scientific knowledge and technological development stand as the primary driver for social change. This makes it a topic of importance in the research field of STS.

The aim of this study was to analyze the complex interplay between the Metaverse as a form of S&T and the wider social context in which it is embedded. In doing so, it focused on the intertwined factors underlying its materialization, expansion, success, and evolution, as well as the key contentions, bottlenecks, and uncertainties that have direct implications for its realization and acceptance. The study has shown that the Metaverse is socially constructed, politically driven, economically conditioned, and historically situated. That is, it is inherently human and hence value-laden, as well as can only be understood as contextualized within the socio-political-economic-historical framework that gives rise to it, sustains it, and makes it durable by material effects and networks. This view has in turn corroborated that the Metaverse raises serious concerns as to determinism, reductionism, social exclusion, marginalization, privacy erosion, surveillance, control, democratic backsliding, hive mentality, cyber-utopianism, and dystopianism. This study concludes that, due to the problematic nature of the Metaverse in terms of its inherent ethical and social implications, there need to be more explicit processes and practices for enhancing public participation and allowing a more democratic public role in its shaping and control, especially early in the decision-making process of its development—when the opportunity for effective inputs and informed choices is greatest.

This study outlines several directions for future research from a variety of perspectives. In this regard, there is a need to critically investigate or engage with:

- Whether and the extent to which the Metaverse is equated with societal progress;
- How and to what extent the performative power possessed by the Metaverse have the potential to "harness" social-psychological, cultural, political, and moral imaginations into a quest for reconfiguring human–world relationships and reshaping urban realities;
- What kind of factors will affect this performativity in terms of either strengthening or weakening the power of language being used by the Metaverse to effect change in the world in the medium and long term;
- How this performativity as well as the development of the Metaverse are linked to the events of the COVID-19 pandemic;
- How human users are pre-configured and their interactions are algorithmized and platformized in the Metaverse;
- To what extent ethics and values are considered in the Metaverse;
- To what extent the social well-being of users is taken into account;
- What kind of new societal norms and political systems are embedded in the Metaverse;
- Who makes decisions and how these decisions are made in the Metaverse;
- Who controls political and economic agendas and how in the Metaverse as a practice of platformization that is increasingly marked by strong government institutional support;

- What kind of control, if any, human users have over their behaviors and lives in the Metaverse;
- What the market cap and economic potential of the Metaverse tell us about the ethical and social concerns in scientific and technological development decisions;
- How to humanize and renature the techno-utopianism of the Metaverse as a virtual alternative to the imaginaries of data-driven smart cities; and
- If it is possible at all for digital/virtual platforms to exist without surveillance capitalism, and if so, what it takes to fight for it.

Meanwhile, as platformization is massively happening in reshaping and reconfiguring every aspect of urban life, relevant questions need to be asked and researched as to whether there are alternatives to dominant modes of deploying and organizing the practice of platformization.

The Metaverse is empirically under-researched and theoretically under-developed for applied purposes, and addressing these research questions is deemed of crucial importance to guide the development of the Metaverse towards social good. When it comes to techno-scientific concerns and issues, one of the key topics that is emphasised in STS as an area of research and policy analysis is democratization due to the problematic nature of S&T. The inherent societal and ethical implications of S&T justify the need for more explicit democratic processes for enhancing civic and public participation in the shaping and control of S&T. Therefore, it is of high relevance and importance to empirically investigate practice-oriented S&T in the context of the Metaverse—Science, Technology and Public Policy (SEPP). This research pertains to the practical policy issues surrounding the design and engineering of the Metaverse as a process of platformization and its institutional dimensions, namely data infrastructure, governmental frameworks, and economic processes. New practices should allow a more democratic role of the public in the ethical and social shaping and control of the Metaverse. This indeed is central to the criticism of data-driven smart urbanism/governance as a form of science and technology with respect to the serious concerns raised by the pervasive and massive use of data-driven technologies in smart cities and that are well illustrated by the Metaverse as a set of speculative representations. Furthermore, philosophical and ethical studies need to focus on analysing case studies of the potential failures of the Metaverse as it evolves into a global platform to reveal about the ethics and values subsumed in this techno-scientific endeavor. The motivation for this future work is to make scientists, computer designers, software engineers, corporate managers, policy makers, and decision-makers much more ethically and socially attuned to the far-reaching implications of their active involvement in the visionary and regulatory work of the Metaverse. In addition, further research is needed to draw on speculative fiction to move beyond the critique of the techno-utopianism of the socio-technical imaginaries of data-driven smart cities in order to diversify ways of thinking and knowing as a means to expand existing imaginative capacities and transformational understandings of future urban worlds.

Methodologically, future work should explore the heuristic potential of the techno-utopianism of the Metaverse as an analytical and critical approach to engaging with the construction of alternative urban futures for the imaginaries of data-driven smart cities. In addition, conducting in-depth historical comparative analyses and evaluative and critical case studies is of particular importance as the development of the Metaverse evolves and become interwoven with everyday life, while treating this phenomenon as cultural and material productions and historical events that are subject to perennial changes. The underlying assumption is that the Metaverse as a form of scientific knowledge and scientific activity is historically determined and embedded and culturally constructed and framed and thus subject to change over time. It follows that it is necessary for the Metaverse to be open to future interrogations, deconstructions and re-interpretations that may lead to abandon or reconfigure its prevailing assumptions, claims, and approaches, as well as its ways of acting and dictating the future of reality.

Given the early stages of its development, the Metaverse is increasingly attracting research. Being in its infancy, this research consists of two main strands, which are typical to the advent of new socially disruptive technologies. The first strand is concerned with the state-of-the-art and technical aspects of the Metaverse, dealing with computing technologies, immersive technologies, ecosystems, applications, opportunities, developments, trends, grand challenges, open issues, research agenda, roadmapping, frameworks, and so on [30,111,132,142,143,146]. The second strand is concerned with the social, ethical, and legal risks and issues of the Metaverse [10,26,27,29–31,137]. None of these studies has addressed the link between the Metaverse as a set of fictional representations and data-driven smart cities as a set of socio-technical imaginaries based on the framework of STS, thereby the original contribution of this study to the knowledge community. Accordingly, the contribution of this study to the scholarly debates in the field of STS is two-fold. Firstly, it provides insights into how scientific and technological development processes are initiated, employed, progressed, increase in value, and possibly vanish. Secondly, it deepens and extends social scientific critiques and understandings of the socio-technical imaginaries of data-driven smart cities based on the analysis and evaluation of the Metaverse as a set of fictional representations of future urban worlds and the warning signals and troubling visions it conveys and animates. This is to help construct desirable alternative futures for the benefit and well-being of all people. Moreover, the analysis and evaluation of the Metaverse and the urban future worlds it imagines corroborates existing social scientific critique of the socio-technical imaginaries of data-driven smart cities.

The fictional representations of future urban worlds relating to the Metaverse have offered important tools for interrogating the socio-technical imaginaries of data-driven smart cities in terms of their virtual incarnation, as well as prompted deeper reflection on the present reality by illuminating the intended and unintended consequences of not-yet realized possibilities and trajectories for urban change. They have offered a series of useful insights into the dystopian or anti-utopian prospects of techno-scientific urban societies, as well as glimmers of hope from which desirable alternative futures might be recovered. There are invaluable lessons to learn from in this regard, as they are capable of shaping how urban societies and human settlements evolve—predicated on the assumption that, following [226], there is no straightforward binary between "fictional" and "factual" cities. This relates in this context to their potential to positively influence urban life or urban culture as a product of the perceptual interactions between humans and spatial/social forms. In this line of thinking, Salerno [113] critically investigates how new ICT plays a role in creating a new system of urban ideas and ideals from the new forms of its use and the imaginaries it produces. Indeed, urban transformations enabled by advanced technologies should embody and imagine urban futures that provide rich opportunities for improving sustainability, equity, inclusivity, resilience, and the quality of life through innovative and responsible approaches to planning and design [227–231] in response to future social risks and global uncertainties. This indeed requires moving beyond a solely deconstructive critique of the risks of techno-utopianism. It follows that it becomes useful to combine normative forecasting and backcasting [79], speculative fiction, and utopian theory. Especially, this combination has the potential to transcend the limits of the techno-utopian critique of the socio-technical imaginaries of data-driven smart cities towards the construction of alternative future worlds. Indeed, for example, drawing on heuristic utopianism, which focuses on the "education of desire" [232], there is a realm of social practices where it is possible to explore the future possibilities of such worlds. A significant strand of utopian theory stresses the function of utopia as a critical approach to systematic critique [233] in order to "open a way to aspiration, to teach desire to desire, to desire better, to desire more, and above all to desire in a different way" ([234], p. 796). As argued by Levitas [235], utopianism enables both the reconstruction of alternatives and the critical analysis of social desires. In this respect, the "utopian approach" is regarded as key to the pursuit of transformative change, allowing "not only to imagine what an alternative society could look like, but . . . to imagine what it might feel like to inhabit it, thus giving

a greater potential depth to our judgments about the good" [236]. This in turn is central to STS as both a research field and applied policy analysis, which holds great promise for the normative and democratic enhancement of techno-scientific societies by serving as a locus of debate. Indeed, much of the raison d'être of STS is to recognize normative concerns and to incorporate ethical frameworks into society's shaping and control of science and technology.

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