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The New Age of Metaverse and the Old School Universe: Business on the Edge of Final Frontiers

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Abstract

The advent of the Fourth Industrial Revolution and its (un)expected follow-ups continue to open up new dimensions of economic, political, and social interaction. The latest is the Metaverse, striving to become as real as our own world for those enmeshed in it. It can be described as an extended-reality-based space and is in the process of being conceived as an emerging/evolving frontier to be conquered as terrestrial space was and as outer space may one day be. The present article grapples with the intriguing question of whether the Metaverse will be a surrogate/refuge from a physically and socially pressing existence or a tool for/facilitator of the exploration of other frontiers – particularly, a substitute or a complement for the ever-glorified expansion into outer space? We contend that there is a degree of overlap between the envisaged Metaverse and man's endeavours toward Cosmos, in the context of resource scarcity, barriers of access, and the new functionalities of command, control, and coordination in mastering outer space as well as other challenging frontiers. Thus, the Metaverse implies, despite its apparent intangibility, scarce resources in terms of matter and energy, and may justify these allocations through new applications and functionalities related to space. Rather than representing an inward-looking frontier, it may enable us to look outward, propelling human aims for immersing into the physical Universe.

Keywords: Metaverse, outer space, technology, scarcity, sustainability.

JEL Classification: L86, N70, O33, Q56, R40.

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1. Introduction

One of the emblematic encounters between what would become the Metaverse and the incessant outer space quest happened in the recent past of the futuristic TV entertainment: the Star Trek's Holodeck. While some Sci-Fi gadgets from the famous series are current commonalities (e.g., mobile communicators, hand-held tablet computers), other advances will be featuring for a while on revolutionary to-do-lists (e.g., tractor beams, warp drives). The Holodeck appears to be a "work in progress" if we scrutinize it against the background of the contemporary Metaverse experiences. The former was a space in which, for recreational and reflective purposes, the inhabitants of the spaceship could interact with "realistic" historical characters in a very "tactile" (fully-sensorial) multi-parametrically programmable environment. The latter is an unfolding offshoot of the internet/cyberspace, blending artificial intelligence, computer graphics, and human-computer interface gimmicks.

Living in a world marred by the vicissitudes of scarcity and the vagaries of sociality, humankind constantly finds challenges/risks/opportunities related to the ascertainment of each and every "new frontier" during his expansionary existence. Initially, man "conquered" pieces of land as an immediate basis for habitat and harvest; then he "conquered" rivers and seas, restlessly moving in search of better stability; then he "conquered" skies and, thence, all the geosphere came under his command; then he "conquered" the electromagnetic fields, the basis of his IT&C-enhanced life; then he understood that his planetary "conquest" is eventually exhaustible and erodible, and the outer space may grant him not only answers to his cosmological conundrums, but avenues for his endurance on/outside Earth (minerals, energy). Or he might have found out as well that some inward, not outward, frontier is available: a somehow "virtual" one, able to economize the costs of his "too physical" existence.

This research presents a perspective that was not explicitly taken so far in the literature: the nature of the relation – trade-off or synergy? – between the development of the Metaverse and that of the space quest, as these economic areas represent "new frontiers" to be explored (e.g., to understand their peculiarities and assorted rules of conduct) and exploited (e.g., to produce wealth more sustainably and to distribute it more socially fair). The clarification of the connection between the allegedly "virtual" Metaverse (yet one needing serious material/energetic inputs, some acquirable from cosmic supplies) and the much more "physical" outer space (yet one needing complex simulations of extreme off-planet phenomena prior to effective deployment of space missions) is consequential for the future of the human species on many accounts, among which resource mastering and social networking. This article briefly screens this germane concern and signals some relevant cases.

2. Problem Statement

The purpose of this essay study is to analyse the crossroads of developing the inward new frontier of the Metaverse and the outward one of the space odyssey, given the reality of scarce resources (i.e., human, natural, financial or technological),

so sensitive to institutional designs (i.e., social habits/customs, norms/legislations). The stake is to observe the competing/conflicting features of this intercourse (viz., in terms of availability/sustainability of scarce resources, needed for the two routes) or, on the contrary, the eventually prevailing compatibilities/complementarities (viz., in terms of each side acting as a critical factor-of-production provider for the other).

Despite these realms first appearing in Sci-Fi works, with the Metaverse much younger than the cosmic imaginary (Boia, 1997), they both became "real estates". The Metaverse introduces the idea of another Universe, a virtual world which allows one to see and live things according to his/her imagination. Even if the concept existed in the area of video games for more than two decades – viz., Second Life, which hosted real banks and commercial deals –, it is starting to raise more and more awareness, nowadays, especially for the people who understand that it can be useful in every domain, from conducting medical procedures to organizing social events (Park, Kim, 2022; Stylianos, 2022). The space quest cannot remain alien to this.

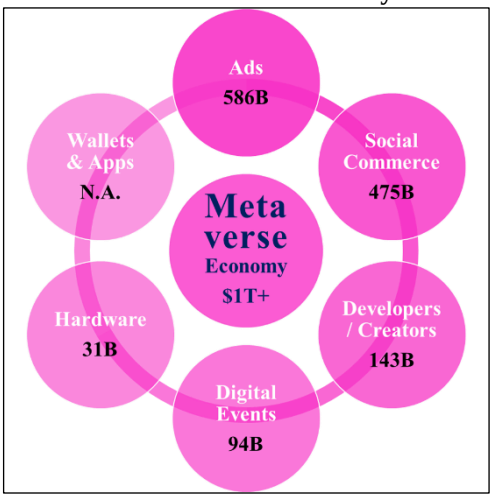
There are many interpretations in defining the Metaverse, the most common one being related to the translation of the real world into a virtual counterpart. And although experts did not manage to establish a standard definition, most of them agreed with some key attributes that "a" Metaverse should possess (Kiong, 2022):

- Persistence – continuous operation, without pause or end date;
- Synchronousness and liveness – a real-world simulation that exists for everyone in real time;
- Multipresence – able to exist in different virtual worlds simultaneously;
- An economic system – the possibility to produce, sell, and buy digital assets, and to be rewarded and recognized as such;
- Coverage – in both virtual and physical worlds, in public and private networks, as well as in open and closed platforms;
- Interoperability – implementable between all the components of the digital world such as digital assets, data, and content;
- Diversity – created and populated by a wide range of social groups, like commercial or informal ones.

From the technical perspective, the Metaverse is a new generation of Internet applications which aims to integrate the interactive/immersive experiences offered by augmented reality technologies and blockchain-enabled economic solutions, in order to build a recreation of the real world. The key concepts that define and build the Metaverse are "avatars" and "extended reality". These two approach the most important traits of the real world: the human and the environment (Ning et al., 2021).

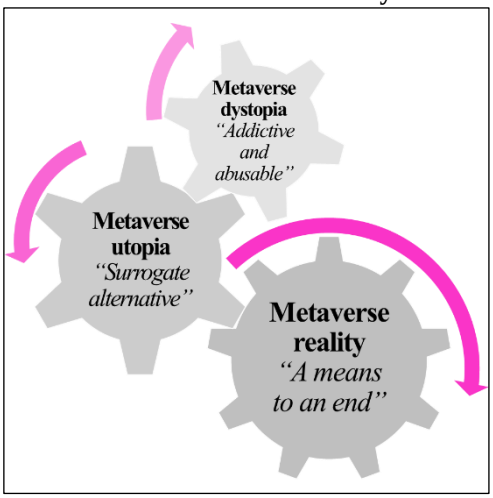
Economically, the Metaverse value chains are responsible for around USD 1 trillion: developers/creators of virtual platforms; traders, entertainers, advertisers; hardware providers of headsets, graphic chips, and omnidirectional treadmills (Figure 1). At the same time, the Metaverse is being subject to different potential evolutions, depending on how humans will adjust their subjective expectations to the objective rapports (of economic laws' nature) between the physical and the virtual (Figure 2).

Figure 1. The "state" of the Metaverse economy



Source: own representation, data from Palandrani, 2021.

Figure 2. A "process" of the Metaverse economy



Source: own representation of original problematization.

Far from the flamboyant "voyages of the starship Enterprise", the present space economy is "the full range of activities and the use of resources that create value and benefits for human beings in the course of exploring, researching, understanding, managing, and utilising space" (OECD, 2019). If being connected in worldwide networks, from a computer or a mobile phone, may seem a triviality today, this would not have been possible without the artificial satellites, giving us instantaneous communications, GPS guidance, 24h television broadcasts, weather forecasts (Becerra, Rodríguez, 2016), as many earthly benefits are space-related (Figure 3).

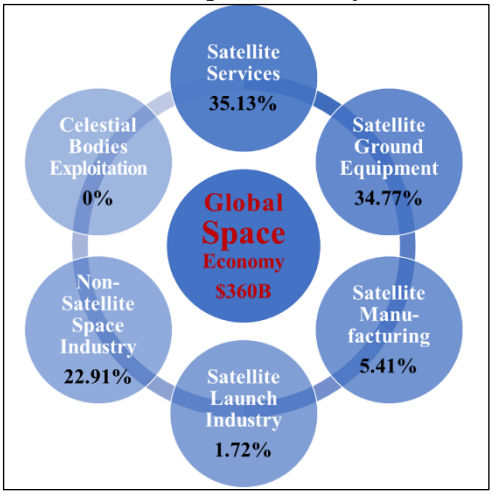
Beyond governments' primacy in popular imagery as well as in strategic designs, the vast benefits of the cosmic economy were brought to final consumers by the efforts of private enterprises. As in the case of the Internet, the state was only the trigger (Jora, Iacob, 2019). The modern space quest is usually split into three major phases (Sommariva, 2018):

- The first one, called the "inventions stage", occurred at the beginning of the twentieth century and included groundwork research with potential space use (including here Hermann Oberth, born in Sibiu and raised in Mediaș and Sighișoara, who was a rocketry pioneer);
- The second stage, between 1950 and 1970, comes with expanding innovations devoted to exploration projects, military concerns, and the first economic views seeing the Cosmos as a commercial sector having infrastructure development needs to be served through public goods;
- In the third stage, after the 1970s, the space economy grew rapidly (such as the satellite sector), culminating with the creation of "New Space" private companies like SpaceX, Virgin Galactic and Blue Origin that tackled the last bastions of state monopoly: launching goods and people.

The inherent complexity and the high operating costs kept the economy of the cosmic space mainly within the reach of the state agents (Launius, 2018; Pietroni, Biglardi, 2019). The excuse of the powerful spacefaring states in their reluctance to share their cosmic findings with the developing ones was their (in a sense legitimate) need to first capitalize on their previous resources deployed in extra-terrestrial exploration efforts, despite all the non-negligible networking benefits (Smith, 1988).

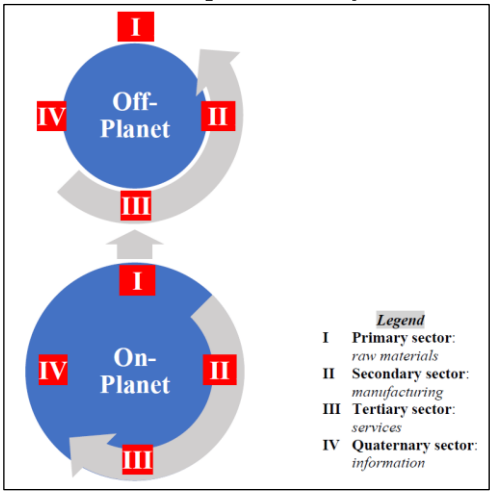
One may also wonder why some space-exploitation activities still look far-off: from manufacturing to mineral extraction, energy provision, and even agriculture – as a digression, we may see a "reversed sectoralization", meaning that the most basic economic activities on Earth seem the most remote in the outer space (Figure 4). Beyond cost reasons, such activities will be further delayed by the "socialist" ("res communis") view from the 1967/1979 international space treaties (Simberg, 2012).

Figure 3. The "state" of the space economy



Source: own representation, data from Bryce, 2019.

Figure 4. A "process" of the space economy



Source: own representation of original problematization.

3. Research Questions / Aims of the Research

The main research questions to which the present study aims to offer answers, bearing in mind that the complexity of evolutions pertaining to the subject matter and their disruptive character defy the use of mere extrapolations, are the following ones:

- Understanding that the Metaverse cannot be a self-sufficient world, for its users do rely heavily on physical supplies not only to develop it, but to live their own flesh-and-blood lives, is the outer space a reliable provider of critical resources?
- Also, conversely, is the Metaverse rather a secluded realm, an escape room from the hardships of traditional life (or a hidden trap?), or a lucrative, training ground that could prepare us for pushing forward existential (including space) frontiers?

- Which are some of the most notable aspects where both the Metaverse and the outer space will require us, humans, to carefully revisit our rules of social conduct (including "social contracts") in order to extract maximum benefits from the two?

4. Research Methods

The research team opted for a deliberately qualitative approach, noteworthy the exploratory character of the study deriving from its novel subject matter. This started with a review of the literature devoted to the technical-scientific and socio-economical aspects of the Metaverse and space exploration current developments. Then, historical analysis and prospective analysis were applied to (qualitative) data associated to the "megatrends"- and "game changers"-types of observed phenomena.

The authors consider that such a methodological approach, which may be considered austere as compared with more sophisticated toolkits for data mining and modelling (usable at later stages of the research), is both proper for the moment and substantially enhanced by the interdisciplinary character of the team that is made up of economists and engineers. The study of broad phenomena with the combined lenses of social sciences and technical sciences is fertile before, eventually, streamlining it.

5. Findings

The following arguments share a vision for a Metaverse and space paradigm advancing more or less in lockstep, although they are currently, more often than not, separate realms affected by their own challenges, risks, opportunities, and dynamics. The areas of overlaps and intersections are potentially very vast, and will only come to fruition in the following decades as capabilities are expanded, a critical mass of users is reached, and new applications are being developed, especially for enterprises.

5.1 "Pride" (in Spacefaring) and "Prejudice" (of Neglect)

One of the most obvious arguments in favour of synergy is that it is unlikely that the Metaverse can totally displace space exploration as an aspirational or positional good that feeds, at the very least, into the willingness of politicians to fund it and of billionaires to make their mark through it. Regardless of the ebb and flow of public and private interest in space, there is still a minimum politically viable investment to be made into it for the sake of scientific discovery. This argument is needlessly modest – the reality of the current profusion of space applications, as well as the heating up of a new Space Race as a dimension of competition between legacy and aspiring powers, guarantee that there will be a significant amount of attention paid to space even if the Metaverse becomes "the" interface between ordinary man and life.

5.2 Gamification as a Teaser and Tester in the Space Quest

It is quite possible/plausible that the Metaverse itself will inspire new generations with wanderlust and a fascination for space that will make the dynamics described above possible. An obvious tray of the Metaverse remains gaming, featuring a near limitless array of aesthetic varieties, some of which veer into Sci-Fi and into plausible simulations. Just like traditional gaming maintains a sizable niche of enthusiasts for realistic simulations of all types, from flying to farming, so too will the Metaverse enable new videogames and other experiences drawn from Cosmos and the enduring fascination of its fans. For instance, there is the X-Metaverse, a blockchain-based Star Wars game, where, as in the vast majority of alike products, the pleas for the "peaceful exploration of space" are secondary to warlike sensations.

5.3 From Edutainment to New Business Models for Space

Beyond simulation of space for entertainment and edutainment purposes, there are other potential contributions in the usage of the Metaverse, for instance in raising funds and designing new business models for space. Already, there are Metaverse games with NFT-based business models such as mars4.me that plan on investing a part of the proceeds into space and giving their players a stake through virtual land ownership (Guha, 2021). This might be a stretch of the imagination, but other outlandish models have been proposed in the past – at the dawn of social media, there was a (failed) plan to fund a Mars mission by turning it into a reality TV show. The interactivity, variation, and user choice of the Metaverse experience can make exotic business models viable in the fiefdoms of space exploration and exploitation.

5.4 Space, Earth's Future Minerals and Energy Purveyor

Space exploration and, then, exploitation may become a necessity for survival in the age of the Metaverse. We have the Sci-Fi standby of the insatiable appetite for new resources on the part of future societies, from the prosaic (various minerals) to the fantastic (deuterium for nuclear fusion). Adding the Metaverse to the global technological civilization in the making, with its necessary huge computing substrate, will likely raise the requirements for "rare earths" (eventually cheaper to mine and ship from the asteroids) and the consumption of energy. Depending on which evangelist of space quest one listens to, the future is either in solar power plants in space, harvesting the Sun's rays continuously and beaming the energy down to Earth, or in mining cosmic bodies for fuel for clean and safe fusion power plants.

5.5 Space-Related Tech to Assist Metaverse Functionalities

A straightforward contribution can also be made to the running of the Metaverse, with satellite communication systems acting as one of the main vectors for global exchanges of information in real time. Other applications include Earth Observation and remote sensing which may inform Metaverse-based simulations of various real world phenomena. Metaverse functioning relies on synced computer systems and databases in disparate corners of the world, and kept organized by the

synchronization services of the atomic clocks that are on-board global navigation satellite systems. SpaceX, Meta (ex-Facebook), and a few other players have drawn up plans for satellite mega-constellations that provide wireless Internet access to remote areas and other services that increase the potential ubiquity of the Metaverse.

5.6 Early Warning Mechanisms for Space-Related Threats

A Metaverse-oriented civilization needs to be reliable, including in the face of high impact low frequency events that may disrupt it with catastrophic results once it is sufficiently embedded in our lives and in our critical infrastructures. The space environment features a wide variety of general and specific risks and threats that require policies and actions to address. One example is the space debris threat to space systems requiring clean-up technology tests in orbit. Another is the impact of space weather, the variety of phenomena emanating from deep space or from our Sun, involving various forms of radiation and other charged particles with deleterious effects on technological systems, including the energy and information ones, be they orbital or terrestrial, that are engineered to make the ubiquitous Metaverse a reality.

The most well-known phenomenon is that of "solar storms" (Cannon, 2013), where the variability of solar activity leads to highs that include coronal flares, which can destroy satellites, short-circuit electricity grids, and even affect undersea cables. They geomagnetic phenomena are a significant threat to technological civilization, with costs estimated at trillions of dollars in direct damage per event. The mitigation of such risks and the growth of the resilience of our interconnected and digitalized world, which is moving toward the Metaverse, will require research into these space phenomena and system hardening, as well as investment into Space Situational Awareness, both in the proximity of our planet and near the Sun, in order to provide early warning so that management and mitigation measures to be promptly activated.

5.7 The Metaverse – A Tailored Tool for Space Exploration

There are already steps in this direction, with NASA reportedly initiating a thematic competition for amateur content developers to send in scenario simulations related to space exploration (Paleja, 2022). In the future, complex simulations will be possible, involving digital twins of man-made systems and accurate and very detailed simulations of the natural environment. The use of the Metaverse for training, for interfacing with space systems and for operating systems in orbit or beyond, directly or asynchronously, through planning interfaces, is foreseeable. This reduces the required presence of human beings in space, thereby reducing costs; yet, if one values human presence in space for its own sake, the efficiencies of remoteness are to the detriment of the very goal of reaching a critical mass of people in space.

It should also be borne in mind that the Metaverse is not just a tool for entertainment, despite the fact that it emerged in association with high-tech ludic habits, but also one for serious work, such as that related to industrial design and engineering. Already, aerospace companies are adopting Metaverse related technologies such as its endemic XR (extended reality) – the blending of MR (mixed

reality), VR (virtual reality) and AR (augmented reality) – to power better tools for the visualization and design of complex aerospace systems such as planes (Boeing being a first mover). Similar approaches may be used in the future to design spaceships and space stations, and to support the modelling and simulation required for safety and security purposes in an extremely hostile environment for human life.

6. Conclusions

This study of the envisageable trade-offs (less plausible) and synergies (more probable) has already inspired the authors to approach new research avenues, intensive in critical and creative thinking, as the present topic reverberates with current convoluted concerns, ranging from environmental (Iacob et al., 2019) to warfare disruptions (Sauer, 2017). These concluding remarks disclose some of them:

- If the Metaverse can displace space exploration as (primary) aspirational or positional good, then it might also contribute to the attainment of the UNESCO's SDG's, since it is implied that it should lower the costs of (many) physical activities. If so, future research will need to look at how the Metaverse can reduce public expenditure on space programs. We know that the governments acted as first-resort economic agent in space due to the latter's inherent complexity, high operating costs, huge risks, and lack of critical economic mass, and it may keep up being like this if the Metaverse will "hijack" the elite of private entrepreneurs.
- There is a true need to find out what are the real costs of increasing the potential/desirable ubiquity of the Metaverse. Are they worth it? Is a Metaverse worth it if it aggravates the living standards in real life? Can a Metaverse-oriented civilization be reliable? For instance, in May 2022, the digital currency Terra Luna fell by more than 90% in a matter of days. This is not the kind of sustainable economy sought after. Such disruptions might lead to catastrophic results not only for the Metaverse, but for the entire (real) economy. The alleged knowledge-based, technology-intensive economy had already experienced bubble bursts (dot.com).
- With the soaring costs of energy (coupled with all current environmental ambitions), one more factor to intensify price pressures would be undesirable. Moreover, a decarbonized energy future, based on renewables and battery storage, will require vast amounts of rare earths, prone to polluting and disrupting mining operations. A balance needs to be reached: the Metaverse (as consumer) and the outer space (as consumer, before being a provider) of critical material and energetic resources should be developed without endangering the proper existence/functioning of planet Earth, which will be, for centuries to come, the only habitat we can afford.

However, to end on a more hopeful note, if the Metaverse can offer scenario simulations that can better space exploration (inter alia), the complexity of it all might be worth it up to some point. The real question is how that point is determined, and whether it will be in the charge of (private) markets and price signals, or in that of governmental planners that orchestrate political/policy (often opaque!) trade-offs.

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