Governance in virtual space:

institutional foundations for virtual environments in the metaverse

Roman Schuijers

Supervisor: Dr. Christian Lamker

Date: 17-01-2023

Master programme:
Environmental & Infrastructure Planning

university of groningen / faculty of spatial sciences

COLOPHON

Title:	Governance in virtual space: institutional foundations for virtual environments in the metaverse
Author:	R.H. (Roman) Schuijers
Student number:	s2953811
Contact:	r.h.schuijers@student.rug.nl / roman.schuijers@aiber.nl
Master Programme:	MSc. Environmental & Infrastructure Planning
Faculty:	Faculty of Spatial Sciences
University:	University of Groningen, the Netherlands
Date:	17 January 2023
Version:	Final version
Supervisor:	Dr. C. (Christian) Lamker
Second reader:	C.A. (Charlotte) Miller, MSc.
Word count:	17.558 words
Page 3 quote:	Benedikt (1991, p. 1)

Cyberspace: The tablet become a page become a screen become a world, a virtual world. Everywhere and nowhere, a place where nothing is forgotten and yet everything changes.

FOREWORD

Dear reader,

In front of you lies my master thesis, titled: *"Governance in virtual space: institutional foundations for virtual environments in the metaverse"*
This thesis is the final chapter of my master programme Environmental & Infrastructure Planning at the Faculty of Spatial Sciences of the University of Groningen, and the final encore to a fantastic period of studying there.

I want to thank my supervisor Dr. Christian Lamker for helping me in this process, for being ready to answer my questions, for having good discussions, and for his patience. I also want to thank Charlotte Miller, MSc. for being the second reader.

I also want to thank my parents and my stepfather Nick for their love and support, and Robin Neef for his presence as a sparring partner.

Writing this thesis has not been easy, and it has been quite the journey, but in the end I am proud to present my work.

Enjoy reading!

Roman Schuijers
Groningen, 17 January 2023

Abstract

The metaverse has solidified its presence in society, and its development continues steadily. The metaverse can be seen as the 3-dimensional iteration of the internet, where humans interact with each other through their avatars. With the internet becoming a space, the research question arose: *How can governance & planning theory contribute to the positive development of human interaction within virtual environments in the metaverse?*

A theoretical framework is presented that first provides a discussion on fundamental technological advancements that make the metaverse technologically feasible, positioning the internet as a space and place. Following this, is a discussion on spatial governance theory.

A multiple case study into two proto-metaverses was conducted, using empirical data gathered from articles and documents to perform a thematic analysis per case. These case studies were then compared and synthesised with the theory. Key findings are that advancements in blockchain technology allow for decentralisation of power over virtual spaces in the metaverse. This decentralisation increases user agency over these virtual environments. Next to this, the degree to which a virtual space resembled physical space was found to contribute to a person's sense of immersion in a virtual environment. This was found to be a factor that increased immersion in human interaction in virtual space. The synthesis with governance theory found that the newfound agency allowed for the creation of new institutions. Concluding, this study poses that blockchain enabled technologies, such as decentralised ownership of digital assets in virtual spaces, allow for the creation and maintenance of institutions of governance of these virtual spaces, and for the societies that live within them. Further research could expand on this, for example by comparing governance institutions and structures in the physical worlds with those found in the metaverse.

Keywords: metaverse, virtual environments, virtual space, governance, institutions, interaction.

CONTENTS

List of figures

List of tables

1. Introduction and background

A phone conversation overheard in 2030:
"Hey man, haven't seen you in a while, want to go for a coffee someday soon?"
"Hey! I'm sorry man, I'm not in town anymore, I just started my new job abroad."
"No worries man, we can meet in the metaverse! I know a really cool bar in Decentraland's art district!"
"Great! See you there in half an hour!"

1.1 Background

Over the last decades, the internet has solidified its presence in human society, with technological developments enabling it to change role and purpose (Naughton, 2016). The latest development is the ongoing creation of the metaverse. The internet is moving from its 2D 'read only' genesis towards a 3-Dimensional interactive meeting place (e.g. Ball, 2022; Leiner et al, 2009). This 3-D iteration of the internet enables people to meet and interact with each other, and with the internet itself, in digital environments. This type of interaction has gained prominence during the Covid-19 pandemic, where 'proto-metaverses' played host to virtual lectures, virtual retail, virtual sports activities etc. (Ball, 2022; Shi et al., 2022). These environments hold equal and similar properties to physical space albeit with noticeable differences, for example the absence of gravity and how virtual space is created (Ball, 2022; Schumacher, 2022). The metaverse is broadly regarded as the next iteration of the internet, where the internet itself becomes *space and place*, and connections with it are ubiquitous (e.g. Ball, 2022; Lee et al. 2021; Parisi, 2021). Though this can be seen as a new development, notions regarding virtual worlds as *place* go back as far as 2003 (Bartle, 2003). Wang et al. (2022) even signal a move towards "Meta-Societies", communities that exist fundamentally through digital connections made and maintained in the metaverse.

Existing worlds

Developing proto-metaverses and virtual meeting places in the metaverse to facilitate these "meta-societies" has gained traction in recent years, being especially boosted by the Covid-19 pandemic (Shi et al., 2022; Ball, 2022). Companies such as Apple, Microsoft, Epic Games, and Google have shown great interest in the metaverse, paired with multi-billion dollar investments (NOS, 2022; McKinsey & Co, 2022). Topping this list is Facebook, who formally changed its company name to Meta Platforms, signalling a drastic turn towards virtual worlds (Meta Platforms, 2021). Beside large tech-companies, architecture firms such as Zaha Hadid Architects are moving to explore digital space. Their interest originated in digital designs, for example that of Liberland (Schumacher, 2022). Though the digital version of Liberland serves as a model for the physical world, the need for Liberland to physically be created is not central (Liberland, 2022; Schumacher, 2022).
The metaverse does not yet exist, and its definition is still under contention. However, on a smaller scale, shared 3-dimensional virtual environments do exist in the form of proto-metaverses. First coined by Ball (2020), proto-metaverses indicate virtual environments that "(A) lack game-like goals or skill systems; (B) are virtual

hangouts that persist; (C) offer nearly synchronous content updates; and (D) have real humans represented by digital avatars." Examples of other proto-metaverses are Decentraland (Decentraland, 2022) and the Sandbox (the Sandbox, 2022). In these virtual worlds, virtual plots of land can be bought, sold, rented out and developed. Trades and ownership within these worlds are founded on blockchain technology (Decentraland, 2022; the Sandbox, 2022). Decentraland has hosted large events such as the Australian Open and the Metaverse Fashion Week, and is home to a virtual Sotheby's auction house (Ausopen, 2022; Decentraland, 2021). Both worlds have seen land purchases of up to 4,3 million dollars (Putzier, 2021). Value attribution of virtual land can be compared to that of physical land, with location, scarcity and commercial potential being predominant (Andringa, 2022). In tandem with Decentraland and the Sandbox, games such as Roblox, Fortnite and Minecraft, where people interact inside a virtual world through their avatar, can be viewed as proto-metaverses (Roblox, 2022; Epic Games, 2022; Microsoft, 2022). Next to this, Earth2, an example of a start-up metaverse company, has ambitions to bring a Digital Twin of the earth into existence in the metaverse, and is on the way to becoming a proto-metaverse (Earth2, 2022).
Access to these environments can be 2-dimensional, the user looks at his avatar in the digital world on his computer screen, or access can be experienced 3-dimensionally, through wearing a Head Mounted Display (HMD) (Lee et al., 2021; Slater, 2009). Improvements in technologies concerning the latter, add to the sense of being present in a virtual environment (Slater, 2009).

The internet as space

Considering these developments, properties of physical space are attaching themselves to the internet. In the environments described above it is possible to 'do things', that before their existence could only take place in physical human living environments. For spatial planners this could mean that their domain is about to expand. Bartle describes this as early as 2003, where he already regards virtual worlds as spaces and places through the lenses of geography and architecture (Bartle, 2003, p. 634-647). Despite this clear connection to human living environments however, there is little to no knowledge within the field of spatial planning regarding planning in and for virtual worlds.

The metaverse and planning

In spatial planning, virtual worlds and digital and virtual technologies are mostly regarded as tools to aid planning in the physical world (e.g. Lu et al, 2020; Yesin et al., 2023). For example, Babri et al. (2022) see the metaverse currently as a platform for data driven smart cities, but use cases are more diverse. Digital spaces are currently broadly used for different applications in the physical world, with architecture as a front runner (Schumacher, 2022). BIM (Building Information Modelling) and Digital Twins (DT) have become all but fundamental to infrastructure projects and data driven city management and planning, mostly serving as visual aids (Lu et al., 2020). BIM models and DTs find themselves in a transition towards blockchain technology, which is particularly beneficial in terms of foremost accountability, security and reliability (Yasin et al., 2023; Lu et al., 2020). Despite this use case being oriented towards the physical environment, it opens up

possibilities for decentralised and transparent data management and improved chains of cooperation (Nawari, 2020), and creates the basis for persistent and perpetual virtual spaces that do not rely on single servers (Bartle, 2003). Despite this connection, this connection is not found the other way around. The is no literature that describes how to use spatial planning and governance for spaces in the metaverse.

1.2 Relevance

In this section I will discuss trends regarding the movement towards the metaverse, and impacts these trends have on society. From these trends, three main reasons for research into the virtual environments metaverse can be distilled. First, I will discuss pragmatic factors that build a case for metaverse research. Second, I describe why the research into space and the metaverse is relevant in the light of fundamentally positive developments, and why acting on these trends can be beneficial for human life. Lastly, I will describe fundamentally negative trends in metaverse developments, why these can be dangerous to society and why research can help to eliminate, or at least mitigate, negative outcomes.
Research in the realm of the metaverse is a pioneering study, as it is an early adopter in the transition of space and place in the internet. It is important to understand the trends, impacts and reasons behind its development in order to make sure that the potential benefits are harnessed while negative impacts are minimized.

Pragmatic drivers

During the Covid-19 pandemic, the internet has positioned itself as a platform to host human interaction when physically meeting proves difficult, allowing individuals to maintain social connections and relationships despite the physical isolation imposed by the pandemic. Social media platforms and video conferencing software have been instrumental in facilitating this, allowing people to stay in touch with friends and family, as well as attend social gatherings and events online.
The shift to online interactions has been particularly evident in the professional sphere, with remote work becoming the norm for many companies and organizations. The internet has allowed employees to continue their work activities remotely, enabling them to maintain productivity and continuity of operations. Additionally, the internet has also played a crucial role in enabling remote education, providing students with access to educational resources and allowing them to continue their studies.
The metaverse could offer solutions to address the impact people have on the planet and the limits of key resources like fossil fuels. As society is becoming more aware of the environmental impact of human activity, the metaverse can provide a more sustainable way to host human interaction while reducing resource use. For example by reducing human travel, or by reducing the necessity for real estate to be used as office space instead of it being used for housing. In this way, the metaverse may provide a solution to the scarcity of resources and contribute to preserving our planet and its resources.

Positive drivers

The fundamental positives of metaverse research include new ways of bringing people together and fostering greater social interaction. For example, the concept of "meta-societies" (Wang et al., 2022) would allow individuals to join virtual communities and interact with one another in ways that were previously not possible. These meta-societies could promote greater social cohesion, collaboration, and knowledge-sharing, as well as provide opportunities for marginalized or underrepresented groups to participate in society. Furthermore, they could have a profound impact on global economic growth and innovation, as it creates new opportunities for business, trade, and collaboration across different industries and unprecedented geographical scales (Ball, 2022).

Negative drivers

Concerns about potential negative outcomes of a highly digitalised human society are a key driver behind this research. In popular culture virtual environments often depict dystopian worlds. In books such as *Snow Crash* (Stephenson, 1992) and *Ready Player One* (Cline, 2018), and in the film *The Matrix* (Lana & Lilly Wachowski, 1999), the physical world has become derelict, with the main characters being trapped in or escaping to a digital world. Though mainly fictional, these interpretations are some of the only few accounts of what human society in the metaverse might be like.

The second main background of negative connotations with the metaverse is its creators. In current metaverse developments, large tech companies are frontrunners (Ball, 2022). These companies have a poor track record when it comes to user privacy and advertisement prominence. At the moment, Facebook is leading in developments for the metaverse, but questions are raised about their intentions (Brownlee, 2022). Fears exist that their aim to be ‘the first to the metaverse’ is grounded in a perpetual yearning for profitability. That focus would have negative consequences for users of the metaverse, possibly aggravating existing inequalities and power imbalances through unwanted surveillance and data collection in virtual spaces. Therefore, it is important that metaverse research also addresses these negative trends and work towards mitigating or preventing them from becoming reality.

1.3 Problem statement, goal and research questions

Problem statement

There is little to no knowledge that bridges the gap between spatial planning and virtual environments, with an extended focus on planning *in* and *for virtual environments*. The 2D iteration of the internet did not call for such a connection. However, due to ongoing developments in technology and society, the internet could soon be perceived as space and human living environment. The aim of this research is to contribute to planning scholarship by forging a connection between planning and governance and virtual environments, that focuses on governance for and in virtual environments within the metaverse. By describing virtual worlds, how they are created and what they are used for, this research aims to position virtual worlds within the metaverse as an addition to the realm of the spatial planner. The goal of this research is to answer the following research questions which will help to achieve the aim of this research:

The Main Research Question (MRQ):

How can governance & planning theory contribute to the development of human interaction within virtual environments in the metaverse?

To answer the main research question, an understanding of the workings of and developments in virtual environments is necessary. Next to this, interaction in virtual environments must be researched, as well as how metaverse spaces are currently governed. To this end, three sub questions were formulated:

- What developments have taken place and are taking place in human interaction ‘to’ the internet? (SQ1)
- How do people experience interaction in and with space in proto-metaverses? (SQ2)
- How is governance of space and place currently present in proto-metaverses? (SQ3)

1.4 Scope and delimitations

Virtual environments currently exist on a spectrum, from ones that are fully connected to or based on the internet, to those that are not connected to the internet Lee et al., 2021). This research focuses on the former, fully metaverse based shared virtual environments, where human interaction is made possible. Also a realm of the metaverse this research does not look into is that of mixed, augmented or enhanced reality (XR, MR, AR, etc.). These are features that are in essence projected onto the physical world, and are therefore not fully virtual. Rather, this research focuses on environments that are fully and only virtual.

A distinction (and choice of words) that is ubiquitous in this thesis is that between the physical and the virtual world. These two definitions have been chosen carefully. In metaverse discourse, philosophical discussions on reality are never far. These discussions do not fit within the scope of this research. Therefore, in this thesis the fundamental distinction is made between *physical* and *virtual* environments, avoiding references to the *real* world.
Because the aim of this research is to create an understanding of the virtual world for spatial planners, emphasis is put on the unknowns to spatial planning, which is the metaverse itself and its technological workings.

1.5 Research design

To obtain the goal of answering the main research question, this thesis is designed as follows. First, a theoretical framework is created using academic literature at its core, enhanced with non-scholarly literature where necessary. This literature review mainly provides an answer to SQ1, however, additionally it provides the conceptual background against which 2 cases of proto-metaverses are held. This multiple case study is the main research method used to answer SQ's 2 and 3. Why this method is most adequate for this research is extensively discussed in section 3. Which cases have been selected will be further elaborated upon in the same chapter. Next, to gain insight in the 2 cases, a document study along with a thematic analysis is conducted to provide answers to SQ's 2 and 3 per case. The results are then discussed individually, and most importantly, in relation to each other. Finally, a synthesis is created between all sub questions to formulate an answer to the main research question. The research design is visualised in Figure 1.

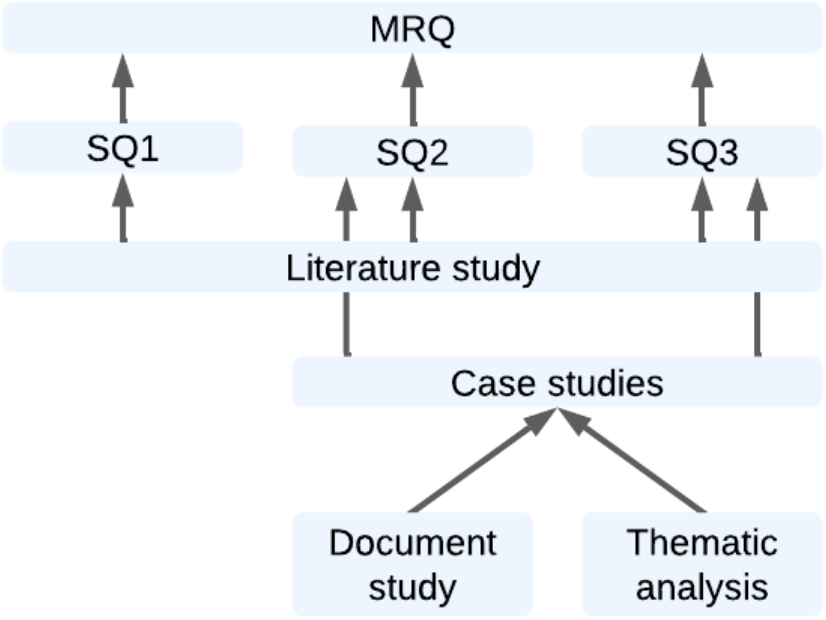


Figure 1: Research design (author)

1.6 Reading guide

This thesis is written on a subject that at the moment of writing finds little connection to the field of spatial planning. It is written from a spatial planners perspective towards virtual worlds, realising that the recipients and readers of this research will mainly stem from the same field. Therefore, an approach is taken that does not assume in-depth knowledge of technical foundations among the public reading this thesis.

Chapter 1 has formed the introduction to this thesis, presenting the reasons for and the directions of study. Chapter 2 will present the theoretical framework within which this study was conducted, as well as the conceptual framework and the hypothesis. Chapter 3 describes the methodology to this research. In Chapter 4 the results can be found, and a discussion is presented that synthesises the theoretical framework with the findings. The conclusion and final answer to the main research question are found in Chapter 5. Lastly, Chapter 6 presents a discussion and recommendation for further research.

2. Theoretical framework

2.1 Introduction

This framework will sketch the boundaries of this research, and in doing so aids in answering all sub questions. First the metaverse is defined, in relevance to the history of the internet. Then, it is key to understand what technologies are fundamental to the metaverse, how they are shaped, and what role they play in current developments. This is followed by concepts related to human interaction with and presence within virtual space are discussed. Afterwards, a theoretical discussion on governance and power theory is presented.

This framework ends with a comprehensible model that describes the metaverse, its relation to the physical world, the position of virtual environments and human interactions within it. Finally, based on the framework, a hypothesis is posed for the outcome of this research.

2.2 The metaverse

Conceptualising the metaverse is best comparable to how the internet was conceptualised in its early beginnings (Schumacher, 2022). At the time of writing, there is no clear definition of what the metaverse is. Therefore, before anything else, this theoretical framework discusses the metaverse, its etymology, and boundaries of its use in this research, as an understanding of the metaverse is also to realise what it is not.

Genesis

When contemporary scholarship discusses the metaverse, more often than not the claim is made that the term metaverse was first 'coined' by Neal Stephenson in his Sci-fi book *Snow Crash* (1992) (Ball, 2022; Lee et al., 2021). Stephenson envisioned the metaverse as a grand boulevard known as *the Street*, donning attributes of physical space to a virtual environment. Metaverse is a portmanteau of the words "meta" and "universe". *"Meta"* comes from ancient Greek, meaning 'beyond' or 'above'.[1] The term metaverse thus implies that it consists of a world beyond or above the universe.

The history of the metaverse

The metaverse in academic literature has remained elusive for decades, but has seen a boom over the last 5 years. There are three discernible waves in literature regarding the metaverse and its surrounding concepts and ideas. The first wave can be identified around the dawn of the internet, Web 1 retrospectively. The second wave of literature 'hits' after the first signs of Web 2 have emerged, with user generated content appearing on the internet. Currently, scholars are riding the third wave, which has come at a time of both technological advancements towards Web 3, and of societal volatility and uncertainty.

[1] As defined by Merriam-Webster

The first wave (seeing the potential, both good and bad)

Around the year 1990 the first signs of human life moving towards digitalization became imminent. The now ubiquitous terms *Virtual Reality* (Rheingold, 1991), *Metaverse* (Stephenson, 1992) and *Cyberspace* (Benedikt, 1991) were first coined and thoroughly described during this period. This wave of literature is characterised by a mostly broad perspective and a futurist view of what internet-based life could have on humanity.

The second wave (the first digital worlds)

The second wave of thought 'hit' scholarship between 2000 and 2010. This wave correlated with the first applications on the internet that enabled people to interact with each other through platforms on the internet (Bailenson et al., 2005; O'Reilly, 2005).

Second-Life was one of the first virtual worlds where people could meet (Davis et al., 2009 ; Kumar et al., 2008). Simultaneously other Massive Multiplayer Online Role Playing Games (MMORPGs) emerged, such as RuneScape and World of Warcraft (Papagiannidis et al., 2008). In this era, different virtual worlds were regarded as different metaverses (Davis et al., 2009; Bainbridge, 2007)

The third wave (towards the metaverse)

At the time of writing, scholarship is going through the third wave of metaverse literature. The metaverse is the topic of research from broad backgrounds. Prominent are those in financial opportunity, virtual real estate and human interaction (Andringa, 2022; Ball, 2022; Lee et al., 2021). Next to this, studies on technological feasibility of blockchain as a foundation feature prominently in discourse on the metaverse (e.g. Buterin, 2022; Lu et al., 2022; Yesin et al., 2023; Zhan et al., 2023).

Defining the metaverse: axiomatic

A hard definition of the metaverse is not yet agreed upon, especially in academia. A comparison can be drawn to the dawn of the internet, when the definition of the internet was under contention (Ball, 2022).

To attempt to define the metaverse, this section ventures outside the environment of scholarship. First and foremost, Parisi (2021) uses a different style of presenting his definition, by proposing 7 axiomatic rules that define the metaverse:

Rule #1. There is only one metaverse. The metaverse is the sum of all real time 3-D rendered virtual worlds on a global and open network, that can be accessed by anyone and is controlled by no one. It ought to be seen as a mass noun *(singular tantum)*. There are not multiple metaverses, or *a* metaverse. This can be compared to websites on the internet, with a website being a 3D world. There are not multiple internets, or an internet, it is simply *the* internet.

Rule #2: The Metaverse is for everyone. Like the internet, anyone anywhere can and should be able to access the metaverse without restrictions.

Rule #3: Nobody controls the Metaverse. Parisi (2021) describes how if any single entity were to control the metaverse, it would by definition no longer be the metaverse. This is because that single entity would not be able to provide the required scale, openness and functionalities. However, the metaverse should be "*intermediated as needs dictate, [and] governed as required for the common interest"*(Parisi, 2021). He mentions decentralised projects as frontrunners to enable this, that are now on their way to first deployment.

Rule #4: The Metaverse is open. The metaverse is and will be a free and interoperable system of technologies, that can communicate by open standards. For this, fundamental protocols that are identical across the network are key.

Rule #5: The Metaverse is hardware-independent. The metaverse should be accessible from any device, of any shape and type.

Rule #6: The Metaverse is a Network. Network protocols will provide the metaverse with a substrata for connecting publicly accessible 3D virtual worlds and experiences.

Rule #7: The Metaverse is the Internet. Except it is enhanced from a 2D interface of websites on a browser, to a spatially organised 3D interface, that is rendered synchronously and in real time.

Ball (2022) synthesises Parisi's axiomatic rules into a single definition of the metaverse as "*a massively scaled and interoperable network of real time rendered 3D virtual worlds that can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data, such as identity, history, entitlements, objects, communications, and payments*." (Ball, 2022, p. 29). This definition, however, leaves out how these characteristics can be achieved and maintained, which according to Parisi will be achieved through decentralisation. Combining these two, the following definition of the metaverse arises: *The metaverse is a global decentralised network of persistent 3D virtual environments, in which an unlimited number of users can feel presence.*

Proto-metaverses

The metaverse as described above does not yet exist. However, environments that showcase many characteristics of the metaverse that are described do exist. Ball (2020) dubs these 'proto-metaverses'. Currently, proto-metaverse can be found as games, such as Grand Theft Auto Online and Fortnite, and in virtual worlds like Decentraland and Second Life[2]. In these worlds, the 'living environment' of avatars is similar to the real world, consisting of buildings and 'public space'. According to Ball (2020), a proto-metaverse is virtual environment that "(*A) lack game-like goals or skill systems; (B) are virtual hangouts that persist; (C) offer nearly synchronous content updates; and (D) have real humans represented by digital avatars*." However, this definition still lacks the decentralisation element that is fundamental to the metaverse and Web 3. Therefore this definition can be expanded with thought

[2] (Rockstar Games, 2022; Epic Games, 2022; Decentraland, 2022; Linden Lab, 2022)

presented by Lee et al. (2021), as factor (E), *'and are environments that promote and enable decentral ownership of virtual assets'*. A significant factor that is lacking is the interoperability between different worlds, as currently each world is a stand-alone environment. Therefore, these worlds are not yet part of the metaverse, but proto-metaverses.

2.3 Technological advancements in the internet

To understand the technological foundations of the metaverse, an understanding of the internet on which it builds is vital, and to understand where the current internet sits, a basic understanding of the history of the internet is necessary. This section sketches a timeline that will describe the main phases the internet has been through, their main characteristics, major turning points, changing use cases and fundamental technological developments. Table 1 shows a timeline of the internet along with its main features per period.

A brief history of the internet

Web 1.0

The first version of the internet, as many technological advancements, was of military purpose (Naughton, 2016 & Leiner et al., 2009). Around 1983, major changes came to the infrastructure behind the 'web', called protocols, which enabled non-military users to access the internet (Naughton, 2016). An example of this is the creation of protocol for the World Wide Web (WWW), the first internet browser, by Tim Berners-Lee (Leiner et al., 2009; Berners-Lee, 2000). Because this protocol was open, other creators could put their websites onto the World Wide Web.
Retrospectively, this version of the internet was dubbed Web 1. On Web 1, the internet was "read only", often compared with a magazine-like structure (Naugton, 2016; Berners-Lee, 2000). The main interaction between the internet and its users was the consumption of information by its users. However, the economic potential of the internet was quickly found, resulting eventually in the dot.com bubble (Cassidy, 2002). Currently, little Web 1.0 pages still exist, as those were not resilient enough to survive the bubble burst (O'Reilly, 2005).

Web 2.0

Web 2.0 can be considered the internet as it is known and used today (Naughton, 2016). Around the turn of the century, after the dot.com bubble had burst, Web 2.0 came to the forefront. Websites that had survived the crash were websites that housed principal characteristics, such as a certain degree of user interaction (O'Reilly, 2005). Referred to as the platform-internet, it allowed users to not only consume, but also produce (Benkler, 2007). Therefore, Web 2.0 is a 'read-write' version of the internet (Naughton, 2016).
Currently, the internet in its Web 2.0-form has a deeply centralised character. Large companies and platforms have accumulated internet traffic and power over recent years (e.g. Facebook, Google), whose revenue model has become more advertisement-based (McKinsey & Co., 2022; Ethereum, 2022a).

Web 3: the decentralised internet

Web 3 is considered the latest iteration of the internet, and it is characterised by giving users agency over the internet and its contents. Blockchain technology is fundamental to this development. In 2008, Bitcoin was created as the first digital only currency that allowed peer-to-peer transactions, without the interference of trusted third party institutions such as banks (Nakamoto, 2008). New blockchain technologies enable proof of ownership within the internet, through the creation of Non-Fungible Tokens (NFTs) (Ball, 2022; Ethereum, 2022b). Fundamental technological changes in recent years have enabled the creation and management of virtual worlds.

Classification	*Time period*	*Role of the internet*	*Users*	*Interaction, interface and use*	*User agency*
Web 1	1983-2004	storing and providing access to information	Consuming information	Magazinelike, 2-dimensional	Reading
Web 2.0	2004-now	Providing platforms for human interaction	Posting & consuming information	2-dimensional	Writing & sharing
Web 3	2008-now	Decentral, Peer-to-peer	Owning, directly communicating	Bitcoin, NFT's, 2- & 3-dimensional	Meeting & owning

Table 1: Timeline of the internet (Author)

Blockchain

Blockchain technology has the potential to play a significant role in the development and governance of the metaverse. A blockchain is a decentralized, distributed system that allows for the secure and transparent recording of transactions across a network of computers (Nakamoto, 2008). This technology has the potential to enable new forms of value exchange and economic activity within virtual reality environments, as well as to facilitate the creation of decentralized autonomous organizations (DAOs) that can govern virtual spaces and communities (Buterin, 2022).

In current traffic, transactions require institutions of trusted third-parties to validate the transaction, as these trusted third-party have the agency to do so (Nakamoto, 2008). This means that transactions flow from a person, through an institution, to another person (Christidis & Devetsikiotis, 2016). These transactions change fundamentally, as blockchain-technology takes away the need for this institutional trusted third party to validate the transaction, allowing transactions to be peer-to-peer (P2P) (Nakamoto, 2008). The blockchain exists of ledgers containing transactions. Before blockchain, ledgers were kept by the institutionalised trusted third-parties, and were known as *'books in which things are regularly recorded, especially business activities or money being received or paid."*[3] On the blockchain these ledgers are no longer in the hands of intermediaries, but they are essentially

[3] According to the Cambridge English Dictionary: https://dictionary.cambridge.org/dictionary/english/ledger

duplicated and distributed across a network of computer systems on a blockchain network. Individual computers known as *nodes*, with unique addresses. Each different copy of the ledger contains information on blocks in the blockchain. Every block in the chain contains a number of transactions, and every time a new transaction is added to the network, a record of that transaction is added to blocks in every participant's ledger. Figure 2 demonstrates a small peer-to-peer network. Each chain of blocks is a copy of the same ledger, so instead of one copy, over 50 or 100 copies of the same transaction can exist. All copies of the ledger must be identical, known as consensus, and it is this decentralized nature of a blockchain network that makes it difficult for any individual party to commit fraud or tamper with it. Lee et al. (2021) summarise these characteristics and advantages in five key points:

- Decentralisation – Users maintain the network without a central manager in the form of a trusted third party in a peer-to-peer system,
- Anonymity – Transactions are completed using algorithms that do not require a connection to a personal ID, ensuring protection of vital information,
- Immutability – Data can hardly be tampered with, as this would require tampering with a plethora of distributed databases,
- Auditability – Every transaction can be traced and checked because of its metadata, and
- Autonomy – Third parties are taken out of the equation by sharing data through protocols, essentially giving agency back to the users.

Next to transactions, proof of ownership can be stored on blockchain ledgers, creating the foundation to Non Fungible Tokens (Ethereum, 2022b).

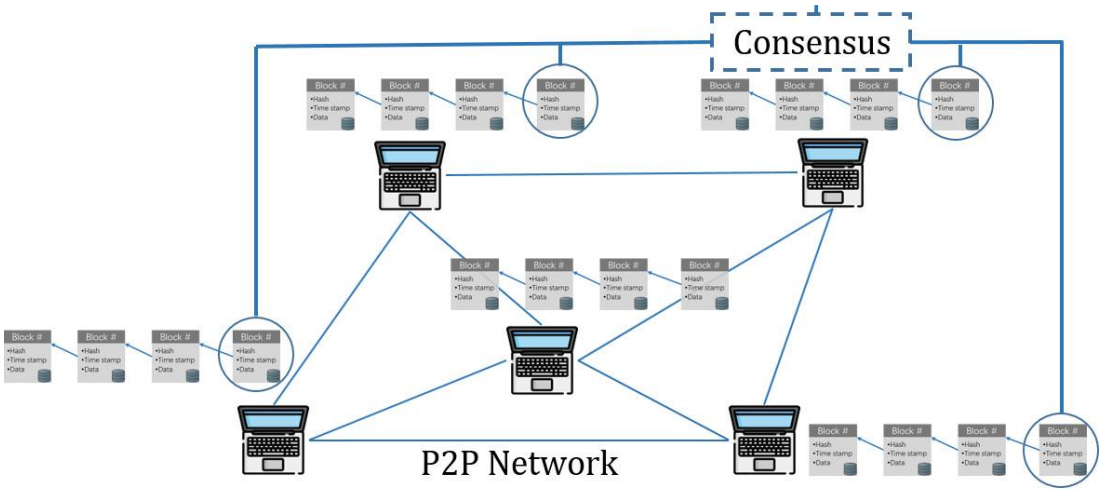


Figure 2: Visualisation of a blockchain network (Lee et al., 2021)

Smart contracts

Smart contracts are fundamental to a blockchain's functioning. Smart contracts take over some tasks of an agent in transactions or data storage, essentially replacing the agents in trusted third parties (Lee et al., 2021; Ethereum, 2022b). One key characteristic of smart contracts is their ability to own and interact with other smart contracts. Similar to the address of an Ethereum wallet, every smart contract has its own address that allows it to own other smart contracts and cryptocurrencies (Lee et al., 2021).

Agency & sovereignty

The concept of sovereignty in the metaverse has two sides, individual agency and the ability of virtual communities to self-govern The use of blockchain technology in the metaverse has the potential to enhance and consolidate this user sovereignty and agency, as it allows for the creation of decentralized virtual spaces that are not controlled by any single entity (Buterin, 2022). This enables users to have greater control over their own virtual experiences and interactions, as well as to participate in the decision-making processes that govern their virtual communities (Lee et al., 2021). In addition, the use of blockchain technology in the metaverse facilitates the creation of new forms of virtual property and assets, enabling users to create and own virtual spaces and experiences similar to how people own physical property in the physical world (Lee et al., 2021; Lu et al., 2020; Putzier, 2021).

However, it is important to note that the use of blockchain technology in the metaverse is still in the early stages of development, and there are many challenges and unknowns that will need to be addressed as the technology evolves (Ball, 2022). For example, there are questions around how to ensure the security and reliability of blockchain-based systems in the metaverse, as well as how to address issues related to scalability and performance (Lee et al., 2021).

Persistence

Persistence is the degree to which a digital world exists when the user is not 'present' (Ball, 2022). Before blockchain technology existed, in 2003 Richard Bartle discussed persistence of virtual worlds. According to him, there were two main forms of persistence of virtual worlds; simulated persistence and true persistence. A truly persistent virtual world is one that "continues to exist and develop […] even when there are no people interacting with it." (Bartle, 2003, p. 2). The physical world is persistent. When people do not interact with it, the space is still there. In a simulated persistence, the virtual world is 'called up' when a game is booted or a person logs in to an online game (Bartle, 2003). Changes that might have occurred are simulated by the game, but have 'happened' (Bartle, 2003).
Blockchain technology has the potential to enable truly persistent virtual worlds by providing a decentralized and distributed system for storing and recording changes and interactions made within the virtual world. This allows the virtual world to continue to exist and evolve independently of any particular user or server, providing a level of persistence that was not previously possible (Ball, 2022; Lee et al., 2021).

BIM & Digital Twins

Persistence virtual environments can already be found in BIM models and Digital Twins Lu et al., 2020). Riding the wave of transitioning to blockchain technology, digital copies are currently widely used in the physical world for a variety of applications, with architecture and asset-management leading the way (Schumacher, 2022). There blockchain based information systems are especially advantageous in terms of accountability, security, and reliability (Yasin et al., 2023; Lu et al., 2020). Blockchain has thus already found its way into use cases in planning and development. Additionally, the metaverse is currently presenting itself as a platform for data-driven smart cities in the physical world (Babri et al., 2022). BIM (Building Information Modelling) and Digital Twins (DT) have become nearly indispensable in infrastructure projects and data-driven smart city management and planning, primarily as visual aids and testing environments (Lu et al., 2020). Despite this use case being oriented towards application in the physical environment, it opens up possibilities for decentralised and transparent data management and improved chains of cooperation, and creates the basis for persistent and perpetual virtual 3-dimensional spaces that do not rely on single servers to exist (Nawari, 2020; Bartle, 2003).

Avatars

In virtual environments in the metaverse, people are represented by their *avatars* (Davis, et al., 2009; Ball, 2020). Bailenson et al. (2005) define an *avatar* as a user-created and operated visual representation and symbolization of a person in a virtual environment. Avatars can be created from two starting points. On the one hand, avatars can truly represent people and their features in an anthropomorphic manner, mimicking the real world (Souza et al, 2022). Currently, Facebook's developments focus on true representations of people (Meta Platforms, 2022). To interact in working environments, it is deemed important for avatars to truly represent the person behind the avatar.
While on the other hand, as seen throughout current proto-metaverses, avatars represent not the person, but who the person wants to be seen as. Roblox (2022) explicitly mentions to users not to give your avatar your real name. Another example of this can be found in *Ready Player One* (Cline, 2018). The main characters in the book have created their avatars to not show their true age, height, gender or facial features (effectively hiding a port-wine stain in the face, for example).

The appearance of the avatar has an influence on the interaction people have with it (Rapuano et al., 2020; Bainbridge, 2007). The level of likeness to a person in the physical world influences familiarity with the avatar of that person (Rapuano et al., 2020; Guadagno et al, 2007). True representation of a person through an avatar and true interaction between two avatars is dependent on latency experienced by the users. Latency is the time it takes for a signal to be sent from one device and received by another. In virtual environments, latency can affect the way that avatars interact with each other. If there is high latency, it can lead to delays in communication and a feeling of disconnection between avatars. This can be particularly problematic in environments where teamwork is important, such as in virtual offices or classrooms.

On the other hand, low latency can allow for seamless and natural communication between avatars, resulting in a more immersive and engaging experience for the users.

Immersion, presence and Place Illusion

Latency is also one of the factors that influence immersion in virtual spaces (Slater, 2009). Next to latency, other measurable parameters such as graphical frame rate, movement tracking, field of view, image fidelity and sound quality determine the degree of immersion, with the overall notion that as each parameter increases, so does the sense of immersion (Slater, 2009). An example of a development that could greatly influence immersion in virtual spaces is that of image rendering engines such as Unreal Engine (Ball, 2022), and improved display technologies in Head Mounted Displays. Creating realistic renders of virtual environments, in combination with improved displays, increases the feeling of immersion of a person in virtual space (Lee et al., 2021). In an early study by Guadagno et al. (2007), it was found that as this technology advanced, people experienced higher levels of presence, to the point where they reported becoming "immersed" in virtual environments (Guadagno et al., 2007).
People interact with the realistic renders through Head Mounted Displays, or VR glasses (Lee et al., 2021, Slater, 2009). Davis et al. (2009) contend that the degree of immersion is found in the sensation of people interacting with and within the virtual world rather than their physical surroundings. A direct derivative of immersion is the feeling of presence, as ´immersion provides the boundaries within which Place Illusion can occur.' (Slater, 2009, p. 3552). Presence in a virtual space is the level of illusion a person experiences to being 'in' that environment (Slater, 2009).
Davis et al. (2009) discuss presence of avatars in virtual space as the sense of being in an environment, represented through an avatar.

Immersion-presence scale.

A causal direction between presence and place illusion and immersion is not certain. The sense of being present in the virtual world depends on varying degrees of immersion, or vice versa (Davis et al., 2009; Slater, 2009) Interactions with 2-dimensional surfaces, environments and websites are considered low interaction and low immersion - a human is looking at a screen – with the person still feeling most present in the physical space he or she is physically in (Slater, 2009). The other end of the spectrum could be defined as 'the ultimate metaverse', where a distinction between the real world and virtual worlds is no longer possible in the case of complete place illusion. The sense of immersion is so that the person feels as present in the virtual world as he or she would in the physical world (Slater, 2009). Figure 3 presents this paradigm.

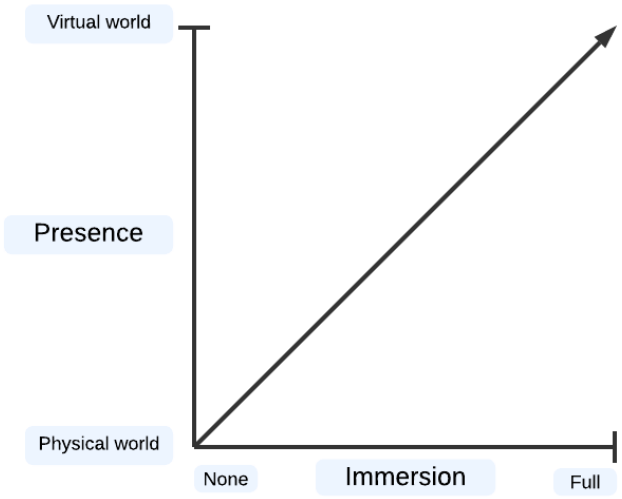


Figure 3: Presence – Immersion scale (author)

2.4 Governance

Governance of spaces is guided by institutions. This following section explains institutions and their ability to adapt, and what the relation is between institutions and power.

Institutions

Essentially, societies are governed by formal and informal rules and agreements, known as institutions (Beunen & Patterson, 2019; de Roo & Voogd, 2015; Searle, 2005). This institutional environment is the arena in which all planning takes place (Alexander, 2005). Human society has attributed *status functions* to objects, people, organisations etc., granting matters that are essentially valueless (like a piece of paper) *deontic powers* that enable that valueless object to act as something with value (a 20 dollar bill) (Searle, 2005). These deontic powers are not solely ascribed to objects, but to people and organisations as well, such as elected officials. Equally important to this ascription is the recognition of their power as such, without which they are essentially worthless (Searle, 2005).

These institutions regulate (inter)actions among individuals, their environment, and government, and they can be inflexible due to factors such as path dependency (Salet, 2018) but also susceptible to change (Beunen & Patterson, 2019). Tao (2016) contends that institutions are not simply rules in a hierarchical order, but also rules that are spontaneously and endogenously shaped and sustained through repeated operational actions. This change is described by Beunen and Patterson (2019) as institutional work: "those actions through which actors attempt to, or in effect do, create, maintain, or disrupt institutional structures" (p. 23). Institutional work can be both intentional and unintentional, as actors can deliberately or inadvertently influence institutions (Alexander, 2005; Beunen & Patterson, 2019). Institutions can be deliberately established to protect shared interests, including financial laws,

regulations regarding the elimination of avatars, and the desired system of government and governance. According to Tao (2016), culture and meaning are important in understanding institutions, which are essentially endogenous agreements between people but appear as desire-independent reasons for action to individual agents, or exogenous enablers and constraints (Searle, 2005). In light of the dual nature of institutional work as described by Beunen and Patterson (2019), it is important to first ensure that unintentional and undeliberate change with malicious outcomes must not become more profound than intentional creations.

Technology and institutions

Rieder (2012) argues that technology has the ability to change the rules of the game, but it does not eliminate political process or power struggles. Instead, it may reconfigure these struggles and temporarily hide them behind the illusion that there is a simple solution to the question of how people should live together. Rieder (2012) emphasizes that technology has made engineering and design a strategic behaviour, as seen in the organizing capacities of web 2.0 applications, where “code is law”. Rieder (2012) also highlights that technology has the ability to change regulative institutions and the means of producing outcomes. He contends that by ungoverned institutionalising of social networking sites, user spaces and user generated content have been commercialised over time. Thus, Rieder (2012) suggests to actively engage with governance and digital politics in order to positively shape new digital institutions rather than letting them unintentionally create themselves, possibly granting too much or wrong power.

Power

Flyvbjerg (2003) posits that power defines reality, with the powerful defining rationality and reality, and even the concept of truth. As Forester (1982) argues, those in power shape reality through their control of information and knowledge asymmetry, ultimately resulting in asymmetry in power. It is important for planners to identify the power relations and institutions that are currently in play within the realm of the metaverse. This understanding is fundamental for instituting change and influencing power dynamics, as noted by Beunen and Patterson (2019) and Flyvbjerg (2003). These power relations and institutions can be found across a variety of realms, all of which are of equal significance for the metaverse, including but not limited to government, lawmaking, governance, ethics, economy, politics, design, and technological foundations (Ball, 2020). Large tech-companies play a major role in the creation of the metaverse, as they possess significant power and control over their respective parts of the metaverse with their technical capabilities and their seemingly endless financial means (Ball, 2022). This power allows them the freedom to define reality within their virtual worlds (Flyvbjerg, 2003) and the ability to resist change (Beunen & Patterson, 2019).

Power and knowledge have a strong connection in the planning process (Van Assche et al., 2014; Flyvbjerg, 2003). One important aspect of knowledge is information, as Forester (1982) states that "information is a source of power." In the planning process, planners can unintentionally or deliberately exert power or create imbalanced power dynamics through the use of information. Therefore, Van Assche

et al. (2014) argue that power is a crucial part of the dynamics of a planning system and that knowledge is closely linked to power. This means that power not only comes from planners and authorities who shape society through planning, but also exists at various levels among actors in the planning process, and can be exerted by the wider community on the planning process. In any case, knowledge empowers those who possess it, but power can also shape the perception of knowledge (Flyvbjerg, 2003).

The communicative turn

Patsy Healey (1996) argues that a "communicative turn" in planning has resulted in a greater emphasis on interactive participation and changes of power relations. This differs from the traditional focus on technical rationality in planning. In traditional planning situations power imbalance in the planning process tends to lead to and follow a technical rationale (de Roo & Voogd, 2015). Asymmetrical power in planning and technical rationalities, therefore, go hand in hand, possibly allowing those in power to cement their powerful positions (Beunen & Patterson, 2019). Healey (1996) contends that planners now aim, or at the very least ought to aim, to create inclusive discourse and foster debate in the changing field of planning. Her thoughts are considered fundamental for contemporary views on planning, establishing the communicative side to the rationalities in planning spectrum by de Roo & Voogd (2015). In this communicative approach, room is created for previously excluded actors to participate in the planning process, giving them the power to act over their own environment (Healey, 1996).
Planners are able to enable people to use this power to change the environment they act in. Thorpe (2017) argues that planners hold two key types of power: reflexivity, through which they shape participation and the planning process to their advantage; and the power to act as agents of city planning. Thorpe contends that the former power is particularly important in "modern" types of planning, as it reflects a shift towards planners as managers rather than experts in "making cities." From this managerial role, planners can provide hands and feet to communicative planning.
In this light, Thorpe (2017) reframes the boundaries of the planning discipline, to not see it as a discipline with clear actions and goals, but to see it as a fluid profession of which the boundaries are fuzzy. As an example, Thorpe notes that while the role of a teacher of the English language may be clear and straightforward, namely teaching the English language, the work of planners is thus not as easily defined.

2.5 Conceptual framework

In this theoretical framework insights have been presented from different key aspects of virtual environments. These aspects have different roles in shaping virtual worlds, and relationships between them are visualised in the conceptual framework in figure 4. The internet, as it is known today, and the metaverse, as it is imagined, are represented on a spectrum. Currently, we find ourselves in the transition from left to right, which is essentially a communicative turn in internet governance. This transition is enabled by technological developments in the realm of blockchain and decentralisation of the internet.

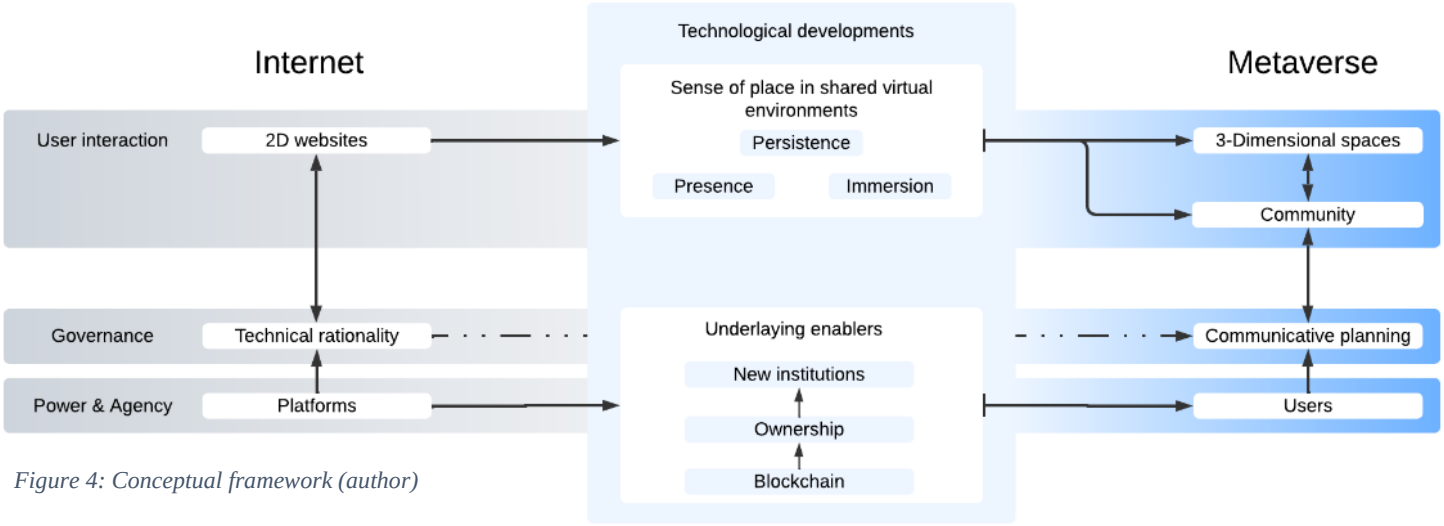


Figure 4: Conceptual framework (author)

2.6 Hypothesis

Based on the conceptual model it is possible to create a hypothesis for the outcome of this research as a preliminary answer to the main research question:

How can governance & planning theory contribute to the development of human interaction within virtual environments in the metaverse?

The hypothesis is twofold; first, the cases under study will showcase that the spaces within the internet are gaining spatial properties that allow people to interact within it and with it in a 3-dimensional environment. Second, because of fundamental technological developments in blockchain technology, new ways of governance of these spaces can be institutionalised, allowing for more democratic control over the internet and one's own digital assets.

3. Methodology

This chapter presents the methodology behind this research. First it describes the literature review. This is followed by an explanation of the chosen method for empirical data collection and an in-depth explanation to how this method was used. This chapter closes with an ethical consideration of the researchers position.

3.1 Literature review

In order to set the arena this research would be conducted in, the previous chapter has posed a conceptual framework. This framework was created from a literature review into key topics such as ‘the internet’, ‘metaverse’, ‘virtual environments’, ‘presence’, ‘avatars’, ‘immersion’, ‘power’, ‘institutions’ and ‘ownership’. Additionally, the literature review provided the researcher with clearer direction and detail by enabling constant reiterating and re(de)fining the aims of this research, the research questions, and perspective (Taylor, 2016). The conceptual framework has created a theoretical basis for space in digital environments, giving a broad overview of fundamental as well as closely related concepts and variables.
To gather the literature in this review the academic search engines of Scopus, SmartCat, Google Scholar and Web of Science were used. For this, search queries were conducted of the concepts in the previous paragraph, as well as similar and related concepts. Nearly equally important has been the review into non-scholarly sources such as blogs, websites, news outlets, and commercial consultancy research. These sources were able to provide a supplemental layer of contemporary literature on the metaverse, especially relevant for the introduction. Furthermore, both forward and backward snowballing have proven meaningful to provide additional relevant literature beyond search queries.

3.2 Multiple case study approach

The aim of this research is to provide reasons for a connection between virtual environments and the planning field. Research into the metaverse is not straightforward, as it does not yet exist. As current metaverse developments are highly divergent, with both fundamental similarities and differences, this calls for a research design with a broad view. Currently, the different virtual environments that exist can be seen as proto-metaverses (Ball, 2020). Within their own respective environments, these proto-metaverses hold characteristics that are fundamental to the metaverse. However, none of the proto-metaverses that exist at the moment hold all characteristics. Because of this, a single case cannot be used to gain insights in generalities. A *multiple case study approach* allows for broader insights into different types of interpretations of proto-metaverses (Taylor, 2016). In this approach, the aim is to identify similarities and differences, and to be able to draw cross-case conclusions on a more general level (Yin, 2018). Additionally, this methodology most suitable to answer the main research question is that of a multiple case study, as this type of study is suitable for answering the ‘how’ questions this research is founded on (Yin, 2018; Taylor, 2016). Specifically, the results from the case studies will be used to answer research questions SQ2 & SQ3. Next to this, case studies are helpful in exploratory research in fields wherein not much previous work

has been done and the phenomenon of interest isn't well understood (Patton, 2002). Using a qualitative approach, this study investigates 2 cases of virtual environments; *Decentraland* and *the Sandbox*. Why these cases have been selected is described in the next section.
In an unexplored field such as virtual environments, it is paramount to find the right balance between depth and breadth (Taylor, 2016). This case study is therefore conducted from a qualitative standpoint, as this provides the necessary depth to build a thorough understanding of each case (Yin, 2018).
Often used as a catch-all term, but definitely applicable in this research, the data collection to build an understanding of the cases under study is funded on the principle of triangulation (Taylor, 2016). The main sources of data collection for this research was a thematic analysis, providing insights in main themes surrounding the governance of the virtual worlds, interaction of people with and within the environments, expectations and predictions, and possible futures regarding the cases. An objective case description was performed by gathering objective documents and data about the cases.

Units of analysis

This research focuses on 2 different virtual environments. The cases that have been selected in this research are *Decentraland* and *The Sandbox*. These cases both present key constituent elements to the metaverse, and can be considered proto-metaverses. Both are household names in metaverse discourse, and both have played key roles in moving the metaverse to the mainstream, as described in the introduction to this thesis (Terra, 2022; Putzier, 2021). Other virtual environments such as Meta Horizon or Roblox do not fit the description of a proto-metaverse as well as Decentraland and the Sandbox, and were therefore not taken into this study.

Decentraland and the Sandbox serve as a showcase of how the metaverse could be technically achieved, through foundations in blockchain technology. Presenting possibilities in governance of virtual space currently not seen elsewhere (Everyrealm, 2022; Lodge, 2022). Decentraland is exemplary when it comes to this novel way of managing virtual spaces, being the first virtual environment to be actively governed by its users (Ball, 2022).
Secondly, the selected cases are regarded highly from a community and gaming point of view. Game developers are currently considered to be one of the main driving forces behind the metaverse, and especially the creation of virtual spaces and communities within them (Bloomberg, 2021a&b). Especially the Sandbox and in a lesser manner also Decentraland have ventured into the metaverse with a community and gaming objective in mind (Ordano et al., 2018; Madrid et al., 2020). This gaming element is considered to be important because online games have featured the ability to create and maintain fully-online communities (Ball, 2022). Next to this, games have played a significant role in transitioning physical activities like concerts to virtual worlds (Ketchum III, 2020). Therefore, looking into an environment that represents this is interesting for this study. Both cases are elaborately introduced and described in the next chapter.

Thematic analysis

The main data collection for the individual case studies was performed through a qualitative thematic analysis of different types of documents and texts about the cases in this study. Thematic analysis allows for a clear overview of main messages of relevant documents, texts, discourse, and underlying themes (Kaefer et al., 2015; Bryman, 2012). The metaverse and developments within it is an emerging field of research which develops at a rapid pace, both in breadth and depth. Currently, ideas, expectations and predictions related to the metaverse and digital life are discursive rather than tangible (Ball, 2022). Much of this thought is still hypothetical and found in discourse surrounding the metaverse. To gain an understanding of these new phenomena a qualitative focus is imperative (Polit & Beck, 2010). Performing a qualitative thematic analysis is an adequate way of looking into this discourse, as it provides insights into themes in texts that are not yet evident in the metaverse (Bryman, 2012; Mayring, 2000; Morgan, 1993). Moreover, this thematic analysis is highly suitable for studying online content, enabling a systematic categorization of texts and documents, assisting to grasp large amounts of information (Miles & Huberman, 1994; Kim & Kuljis, 2010). Generating a somewhat quantitative overview creates the possibility to distil certain themes that through re-reading could then be analysed more in depth (Morgan, 1993).

Data collection and treatment

Data collection for the thematic analysis comprise of finding articles, documents and blog posts. The search has been performed through using the Google search engine and the UG Nexis search engine, and through snowballing from relevant searches (Taylor, 2016). Next to text based sources, relevant discussions for this thesis could be found in non-text based sources such as online videos.
Search queries were formed through combining the name of the case, Decentraland or (/and) the Sandbox, with concepts deriving from the conceptual framework created in section 2.5. The cut-off point for data collection was set at 31 December 2022. The search for articles regarding the Sandbox was difficult, due to its homonymity with other concepts in spatial planning.

Search queries (with Boolean operators)	Boolean operators	Additional search terms (or synonyms)	
Decentraland	AND	Space	presence
the Sandbox	OR	place	persistence
metaverse	NOT	land	“human interaction”
	AND NOT	governance	community
		ownership	immersion
		cities	Public space
		planners	urbanism

Table 2: Search queries for empirical data collection

During the process of searching for sources related to the terms in Table 2, it became clear that search terms in the right column were not well represented in news articles. This resulted in few concrete results when searching for “Decentraland” AND “public space” or “the Sandbox” AND “space”. However, other simpler terms were

used to describe public space in the metaverse, such as *roads, streets, squares.* Using these in search queries, and by closely reading what was meant with these words, articles could be found that discuss space without calling it so.
To maintain uniformity, each data source has been copied to and kept in its own Word document. To achieve this for video content, videos have been transcribed using the automatic transcription software provided by YouTube. As the analysis is thematic, manual and verbatim transcriptions are deemed unnecessarily labour-intensive (bron transcription). In total, 39 texts have been selected, of which 19 discuss Decentraland, and 18 discuss the Sandbox. All documents were numbered *DCxx* or *SBxx*, and are listed in Table 3. Additionally, the Whitepapers of Decentraland (Ordano et al., 2018) and The Sandbox (Madrid et al., 2020) were used in the thematic analysis, as these documents provide insight in the expectations of the developers themselves. They have been named *DC20* and *SB19* respectively. All data has been stored on the secured computer of the researcher. The articles have been coded and analysed through Atlas.ti software. A list of all sources can be found at the end of this chapter, in Table 3. An extensive version can be found in Appendix A. When a source is discussed in the following chapters, this is done following its *assigned number.*

Data analysis: operationalization & coding

The data analysis follows the structure of a thematic analysis, as discussed by Maguire & Delahunt (2017) and first described by Braun & Clarke (2006). This structure consists of 6 subsequent steps to conducting a thematic analysis: (1) becoming familiar with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining themes and (6) writing up the analysis (Braun & Clarke, 2006).
In this thesis, step 1 was conducted during the data collection process, when data sources were thoroughly read and familiarised. Step 2 has been done following the theoretical framework of this thesis, coding the texts with the deductive codes and preliminary themes. These were created directly based on the conceptual framework of this study, maintaining its train of thought (Lewins and Silver, 2007). Next to this, inductive coding enabled the author to gain an understanding of interesting data that could not be ascribed to deductive codes, and could remain close to the original data source, giving way to possible new and interesting insights and themes beyond the theoretical frame (Given, 2008). Inductive codes are marked with a tilde (~) and have been accommodated under one of the preliminary themes, or were left themeless until step 4. This was followed by step 3, wherein matches were sought between the inductive codes and preliminary themes. In step 4, these preliminary themes have been reviewed, using insights gained from the deductive and inductive codes, and (mis)matches with the preliminary themes. By looking at the occurrence frequency of codes, co-occurrence of codes in quoted sections of text and/or high attributed importance, codes and themes were matched and grouped. Finally, the themes have been (re-)defined in step 5 and presented in chapter 4.

The deductive codes are derived from the conceptual framework similarly. The theoretical framework is operationalised through the creation of a combination of deductive and inductive codes, assigning specific and concise values to elements of text. The full code book can be found in Appendix B.

3.3 Researchers position

As an ethical consideration, the potential for researcher bias towards verification must be acknowledged in the conduct of a case-study, as this bias may lead to a confirmation of preconceived expectations (Flyvbjerg, 2006). This is due to the inherent subjectivity in the interpretation of results in qualitative research. However, it should be noted that case-studies do not inherently possess a greater potential for verification bias than other research methods (Flyvbjerg, 2006).

Assigned number	*Title*	*Year*	*Author*
DC1	[VIDEO] Lecture/seminar for the Friedrich Naumann Foundation for Freedom, Potsdam	2022	Schumacher, P.
DC2	Decentraland Now Allows LAND Owners to Rent their Metaverse Spaces	2022	Cryptoflies
DC3	In the metaverse, you can basically do anything you want, so why does it all look much like our normal world, ask Luke Pearson and Sandra Youkhana	2022	Pearson, L. & Youkhana, S.
DC4	Roar Opening Meta Space Studio, An Architecture And Design Service, Within Decentraland	2022	Muhammad, I.
DC5	Decentraland: A Pioneer in the Open Metaverse Category	2022	Everyrealm
DC6	Can public space be created in the metaverse?	2022	Florian, M.C.
DC7	Designing Genesis City: Roads & Urban Planning	2018	Waldorf, T.
DC8	The Metaverse in Practice: How to Build in the Digital Space	2022	Ghisleni, C.
DC9	Do companies need a metaverse voting policy?	2022	Holland & Knight LLP
DC10	New York, Paris, Milan, Decentraland; Global Fashion Goes Virtual with the World's Biggest Metaverse Fashion Week to Date	2022	Thomson Reuters ONE
DC11	Metaverse? It's just a poor video game	2022	Faber, T.
DC12	Metaverse Fashion Week Returns In Spring 2023 To Highlight Advances In Digital Fashion & Interoperability	2022	MENAFN
DC13	Opportunities And Legal Implications In The Metaverse	2022	Ropes & Gray LLP
DC14	The open road to the metaverse	2022	Pandit, K.
DC15	Cities and the metaverse	2022	National League of Cities
DC16	Metaverse and the shifting notions of public spaces	2022	Borgohain, A.
DC17	Decentraland	2021	Grider, D.
DC18	Decentraland: The Metaverse's Early Mover	2022	Gabriele, M.
DC19	Decentraland LAND - What drives long term value	2020	Decentral Games
DC20	Decentraland Whitepaper	2018	Ordano et al.
SB 1	What is The Sandbox? The Ethereum NFT Metaverse Game	2022	Hayward, A.
SB 2	Gucci Opens Its Land In The Sandbox To The Public	2022	Ellis, J.
SB 3	Know Everything About Sandbox Metaverse	2022	Weston, G.
SB 4	History and present, in the virtual; Tania Candiani	2020	CE Noticias Financieras English
SB 5	The Sandbox Reveals How To Travel Through Their World	2020	Hoogendoorn, R.
SB 6	Introducing: The Sandbox Transportation system	2020a	the Sandbox
SB 7	Animoca Brands subsidiary The Sandbox partners with Webhelp to design metaverse community engagement	2022	Joseph, E.
SB 8	The Sandbox and Wunderman Thompson join forces to develop new experiences in the metaverse	2022	ArabAd
SB 9	[VIDEO] Slush 2022 - Fireside Chat Between Sebastien Borget (The Sandbox) and Timmu Toke (Ready Player Me)	2022	Borget, S.

SB 10	The Sandbox Announces Multiple Hong Kong Partnerships to Create Mega City in the Metaverse	2022	Cheng, A.
SB 11	The Sandbox sells $1.66M of virtual land for its metaverse	2022	Takahashi, D.
SB 12	What is The Sandbox Alpha Season 3?	2022	Moreland, K.
SB 13	The Sandbox Metaverse Hits 2M Users — K-Pop Partnership Underway	2022	Say, N.
SB 14	Animoca Brands' Sandbox unveils Mega City 2 cultural hub; to propel Hong Kong metaverse	2022	Proactive
SB 15	Sandbox vs. Decentraland [2022]: Metaverses Come in Different Sizes	2022	Marquit, M.
SB 16	Transportation and portals	2020b	The Sandbox
SB 17	The Sandbox opens new virtual neighborhoods with three LAND sales	2022	The Sandbox
SB 18	[VIDEO] These Architects are Building the Metaverse	2022	Mills, F. & MacAree, G.
SB 19	The Sandbox whitepaper	2020	Madrid et al.

Table 3: All documents used for the thematic analysis

4. Findings

In this chapter, the empirical findings for each case are discussed, first for Decentraland, followed by The Sandbox. First the case is extensively introduced and described. Following the case description, the findings of the thematic analysis of each case are presented. The thematic analysis identified 3 themes. The themes *(1) governance* and *(2) interaction* were conceived as preliminary themes. Theme 1 remained unchanged apart from the addition of inductive codes (~marked between two tildes ~). The thematic analysis redefined theme 2 into *interaction and virtual spaces*, and found an additional theme, defined as *(3) expectations and predictions*. For each theme, the underlaying code occurrence is presented, providing insights in how often a certain code was attributed to texts surrounding each proto-metaverse. The discussion of the findings in the thematic analysis follows, using quotations from coded sections of the data.

4.1 Decentraland

Decentraland is a 3D virtual world that is fully owned and governed by its users, based on the Ethereum ecosystem. In Decentraland, users are part of a shared digital experience through representations of their avatars, where they can socialise and interact with each other and with the virtual world, and being able to buy and sell real estate, wearables, and collectibles (Ordano et al, 2018).

In 2015, Decentraland was founded by Argentinian developers Ariel Meilich and Esteban Ordano (Decentraland, 2022). During this time, Decentraland's focus was on constructing the infrastructure and tools needed to enable users to create and experience content within the virtual world (Ordano et al., 2018). This included the development of a virtual reality engine and user-friendly tools for creating and customizing virtual experiences. Additionally, because the platform introduced its own native virtual currency running on the Ethereum blockchain, users can buy and sell virtual land and pay for goods and services within the virtual world. As the platform gained traction, the Decentraland team worked to bring more users and developers onto the platform and cultivate a thriving ecosystem of content and applications. This was achieved through hosting events such as hackathons, which aimed to encourage the development of new ideas and demonstrate the capabilities of the platform. Figure 5 presents a snapshot from within the environment, and a map of Decentraland.

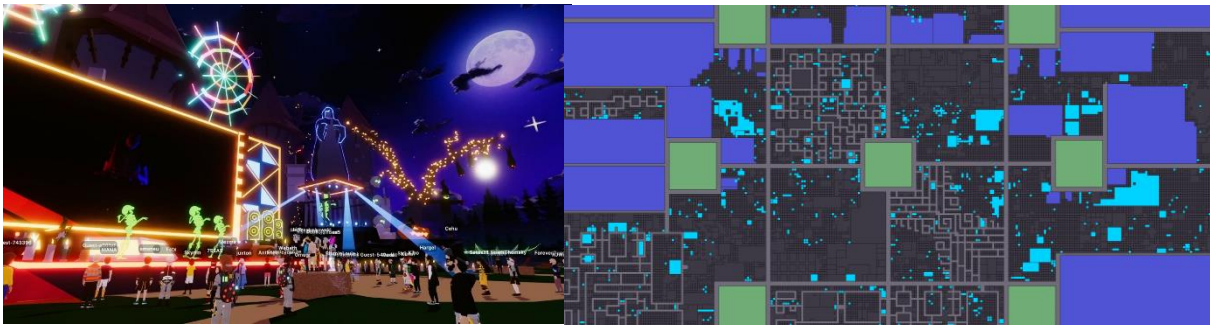


Figure 5: A snapshot from within and a map of Decentraland (Euronews, 2021; NFT Now (2022).

Native cryptocurrency and other tokens

First and foremost, Decentraland is based on the Ethereum smart contract blockchain. In 2017, the platform launched its initial coin offering (ICO) of its native cryptocurrency MANA, which was successful in raising over $24 million and attracting a community of early adopters interested in the concept of a decentralized virtual reality platform (Icodrops.com, 2023). MANA is a volatile cryptocurrency, currently trading at around 1 MANA = $0,3219[4]. Early 2021 saw a sudden spike in interest for everything non-fungible, this hype did not skip Decentraland, with MANA prices peaking at $5,90 (Lodge, 2022). In this period, parcels of LAND were sold for prices equivalent from $6.000 to more than $100.000. Late 2022, Decentraland had an estimated market valuation of $ 2,5 billion (Lodge, 2022).

Technical background

Like its digital currency, ledgers of ownership of land parcels in Decentraland's virtual world are kept on the Ethereum blockchain (Ordano et al., 2018). These parcels go by the name LAND, and are non-fungible assets. Properties of every LAND are kept in the blockchain based ledger, these are; a unique set of (x,y) coordinates; the owner; and, a reference to a file stating the owners intention with the LAND, indicating its 'land-use' (Ordano et al., 2018). In Decentraland, parcels of LAND can only be purchased through its native currency MANA. When P2P sales of LAND are made in Decentraland, these are registered in the same blockchain based ledgers. Similar to cryptocurrencies, only a fixed amount of LAND will ever be created, 90601 parcels (Ordano et al., 2018).

The content of Decentraland (e.g., what is featured on each parcel of LAND) is stored in a decentralised storage system, currently using BitTorrent infrastructure (Ordano et al., 2018). This means that, unlike Facebook and Google, information about the virtual world is not stored on a single server, but can be fetched from a plethora of different nodes. As Ordano et al. (2018) put it in the Decentraland White Paper:

> *"This allows the world to exist as long as it has users distributing content…" (Ordano et al., 2018, p. 9)*

Governance

Decentraland is unique in the way it is governed. Already foreshadowed in the previous paragraph and in the name of the project itself, Decentraland does not have 'a' governing body or central server, by designed nature it is decentralised (Ordano et al., 2018).

When it was first created by Ordano and his peers and during the proof-of-concept phase, control over the virtual world was still held centrally by its designers. However, soon they transferred power over Decentraland over to smart contracts and Decentraland's users, turning Decentraland into a Decentralised Autonomous Organisation (DAO) (Ordano et al., 2018; Lodge, 2022). In this transfer of power, a

[4] Snapshot of MANA value, from https://coinmarketcap.com/currencies/decentraland/ at 4 January 2023.

part of the MANA smart contract was designed to self-destruct, setting the workings, token creation and maximum tokens in circulation in stone (Decentraland, 2023a). The Decentraland DAO consists of two parts: Part 1 is a group of smart contracts that can carry out specific, pre-defined tasks and maintain ownership of LAND and MANA. They operate in a way that they will only complete tasks under certain conditions, such as the passage of a proposal voted on by token holders (e.g. regarding use of public LAND). All of this occurs on a blockchain, hence the name "decentralized autonomous organization" (Decentraland, 2023a). However, operating and governing fully on-chain can be costly. Therefore, Part 2 of Decentraland's governance takes place off-chain. To create the link between off- and on-chain, a so-called 'DAO committee' was institutionalised. This committee consists of three trusted individuals, that together have the power to act on-chain, and to interact with the smart contracts (Decentraland, 2023b). This committee operates for a set amount of time, after which users vote for new members of the committee. Through a separate voting system, users can vote on proposed new committee members, or on other issues such as community grants, changes to the platform, or the design and use of public space in Decentraland (Decentraland, 2023b).

Themes

The findings are discussed per theme, starting with governance, followed by interaction, and expectations and predictions. First, a general overview of the findings per theme are posed using an occurrence table. In each table, we find a quantitative overview of how often certain topics have been discussed. Following each table, quoted and coded sections of text are discussed in depth and in relation to each other. Codes are discussed together when the data suggests a relation between codes (e.g. co-occurrence or high attributed importance).

1. Governance

First, this section discusses governance in Decentraland. Table 4 presents the occurrences of the codes in under the theme governance.

Theme: Governance	*Occurrences*
~DAO~	32
Decentralised	22
Ownership	19
~Planning~	31
User power & agency	16
Web 3	9
Total	113

Table 4: theme governance code occurrence table for Decentraland

DAO – User power & agency – Decentralised – Ownership

Decentraland is governed by an institution called the Decentralised Autonomous Organisation. The data showed that decentralised blockchain technology is the main constituent factor of the Decentraland DAO. Without blockchain technology,

decentralised ownership of digital assets is not possible. This ownership was shown to be key to, as user power and agency in the Decentraland DAO was found to be ascribed to Voting Rights directly attributed to ownership. Voting Rights allow users to vote on a broad spectrum of issues in Decentraland. Smart contracts are found to be fundamental to this governance structure of Decentraland. *DC13* compare smart contracts to organisational structures in the physical world. The difference they discuss is that in the physical world agreements regarding ownership of property, security, copyright, trademarks, etc., are derived from laws, contracts and regulations, while in virtual decentralised worlds, these are replaced by smart contracts stored on-chain, referred to by *DC 13* as 'code':

"Decentralized autonomous organizations, or DAOs, are virtual entities where the governance structure is specified in code." (DC13)

Most importantly, these smart contracts can function almost autonomously, for example in facilitating peer-to-peer financial transactions or the transaction of ownership *(DC13).* Additionally, smart contracts can be subject to auditing to ensure their proper functioning *(DC18).* Transactions are *decentralised*, removing the necessity for centrally controlled organisations. Additionally, this *decentralisation* safeguards virtual environments from being vulnerable to being governed by organisations with questionable ethics *(DC1, DC11).*

"In Web3, DAOs will serve as governance structures to accomplish the collective objectives of a group" (DC13).

However, smart contracts are not completely autonomous, and some degree of human interaction with them remains necessary *(DC13, DC 9).* This can be warranted through smart contracts that can constitute a DAO. Through ownership of MANA or LAND, smart contracts attribute Voting Rights to users that can be elected into a DAO committee *(DC13).* In Decentraland's governance structures, user power and agency was found in these Voting Rights. Users of Decentraland can vote on matters through the DAO when they are an owner of either LAND or MANA *(DC20).* A record who has the right to vote is kept on-chain and this information is publically accessible. *DC1, DC3, DC9, DC12, DC13, DC16, DC18 & DC20* directly link DAO's with *user power & agency* over their environment.

"Decentraland's DAO is key to its claim that its metaverse is "decentralized," because the power to govern much of the metaverse is not held by a single entity or owner, but is instead held communally by its users.. With the power to vote, however, comes the obligation to take positions on issues." (DC9)

The Decentraland DAO is in control over the Decentraland Foundation. This foundation stores financial assets and is the connection to the physical world.

~Planning~ – DAO

Decentraland has already seen varying degrees of contact with ~planning~. DC1 directly connects the DAO to planning, placing planning as a task of the DAO. In this position, the DAO is acribed direct power over and influence on virtual spaces.

"the DAO itself can also do a lot of public investment into in infrastructure and public spaces" […] "particular urban planning regimes which would […] be a sub department if you like[…] to the DAO " (DC1)

Within Decentraland, the community actively engages with the spaces. For example, the way the map is created, on a grid, with a road structure, squares and plaza's, is partially influenced by its community(*DC3, DC5, DC 7)*.

"The community made some impressive contributions to our early urban planning efforts including an array of creative solutions." (DC7)

2. Interaction

Theme: Interaction	*Occurrences*
Avatar	33
Community	53
~Enhancing accessibility~	3
Immersion	16
~Metaverse space design different from physical world~	13
~Metaverse space design similar to physical world~	15
Persistence	4
Presence	3
~Public space~	65
~Spatial~	30
Total	235

Table 5: theme interaction code occurrence table for Decentraland

Communities

Within Decentraland, communities are built around interests and content, rather than geographical limitations *(DC6, DC16).* This differs from communities that exist in the physical world, fundamentally because of the lack of place-attachment in the physical world. However, as the sense immersion and presence in Decentraland increases, so does place attachment.

Community becomes really important for building meaningful social worlds, actually building communities where people feel invested like they are building something here," says Chalmers." (DC16)

"Hence, it is logical that the real catalyst for value creation in Decentraland lies entirely in the content […] considerable value will be created by developing content that brings back return users" (DC19)

To maintain these communities, the factor of persistence is paramount. A persistent world is one that continues to exist even when people leave, and where changes to the world are saved and kept. This enables communities to gather in and come back to the same spaces *(DC6)*.

"Since the connection is not dependent on physical location, the global network offers a large pool of possible connections to choose from, with common interests and principles being the aggregators that form communities." (DC6)

Immersion – Space – Space design

The codes spatial and immersion often occurred together in the data. Spaces in Decentraland are designed in two categories, spaces that resemble physical spaces and spaces that do not resemble physical space. The former is more prominent than the latter, as the degree of immersion felt by users is greater in recognisable environments. *DC 3* and *DC16* describe how spaces in virtual worlds are created along these familiar architectural and urban characteristics, to enhance the feeling of immersion in Decentraland.

"because everything in the metaverse is built from scratch, technically you don't actually have to reference the real world in your designs. But many people choose to do so anyway. They plump for familiar architectural characteristics in their virtual buildings because it makes it easier for participants to feel immersed." (DC3)

"Companies in the Metaverse are also focusing on the recreation aspect by considering designers to design therapeutic and rejuvenating landscapes based on immersive vision and sounds. The intent is to create architectural and landscape setups which are soothing and interactive. […]It looks more like a spatial mood board of random "cool-looking" imagery taken from the real-world itself." (DC16)

DC18 goes one step further, posing spatial characteristics and immersion as equal and interchangeable.

"Instead, Ferreira advocates for either "spatial web" or "immersive web." (DC18)

Avatar

Avatars are the representations of people in Decentraland. Through their avatar, people interact with others, the world around them and items in the world (DC1, DC12, DC14). DC1 links the representation of a person through his or her avatar with degrees of immersion. The more realistic an avatar is rendered or represented, the more its presence in a space can be experienced.

3. Expectations and predictions

Theme: Expectations and predictions	*Occurrences*
~Certainty about future of the metaverse~	4
~Uncertainty about future of the metaverse~	5
~Expectations~	24
~Metaverse as an extension to physical space~	8
~Negative attitude~	3
~Positive attitude~	9
Total	53

Table 6: theme expectations and predictions code occurrence table for Decentraland

Positive and negative attitudes

Expectations and predictions about the future of Decentraland are divergent. User numbers and financial predictions are regarded with positive attitudes, ranging from predictions about user numbers and investments to general interpretations.

"Decentraland has the opportunity not just to be the hottest property market but the next social network. […] Decentraland is positioning itself to become the number one social network in the world used for social gatherings…[…] Facebook and other social media platforms have in the hundreds of billions of market capitalization. I think that's where Decentraland should be in the next few years as…the network grows from 500,000 - 600,000 monthly active users to 600 million monthly active users" (DC18)

"But I think the future is…everyone in the world using the metaverse." (DC18)

However, negative attitudes and fears exist that problems in society will be copied into the virtual world, DC15 predict:

"Without care, the things we create will engender the same biases and societal ills that already exist in the physical world. Gentrification in the metaverse has already sparked concerns. […] the 2022 metaverse land boom is the "first digital gentrification in history. (DC15).

4.2 The Sandbox

The Sandbox is a 3D virtual world that operates within the Ethereum ecosystem and is completely owned by its users (Madrid et al., 2020). As the name suggests, there is a playful element to the world of the Sandbox, which is mostly represented in the voxel art style most well-known from Minecraft, the world's best-selling game in the *sandbox* genre (Everyrealm, 2022). Within the Sandbox, users are able to engage in a shared digital experience through the representation of avatars, allowing them to socialize and interact with one another as well as with the virtual world. Additionally, users have the ability to create and purchase real estate, wearables, and collectibles within the Sandbox. At the moment, the Sandbox has not officially been publicly launched, with it still being in its 3rd alpha testing season (Everyrealm, 2022). Figure 6 presents a snapshot of the environment in The Sandbox, figure 7 is a map of the environment.

The Sandbox was initially launched in 2012 as a 2-D mobile game for Android and iOS devices (the Sandbox, 2019). Today, it is recognised as one of the leading proto-metaverse platforms, with over 1 million monthly users (Everyrealm, 2022). The platform was first created by developers Arthur Madrid and Sébastien Borget (the Sandbox, 2022). After it was purchased by Animoca Brands in 2018, the game was transformed from a 2-D pixel-art based world to an open-world 3-D voxel based virtual environment. Voxels can best be compared to squared pixels or cubes, this voxel style is most well-known from Minecraft. It serves as a platform for human connections, experiences, trading and gaming. Currently, the Sandbox is transitioning to being an on-chain proto-metaverse, decentralising ownership of parcels of LAND. The Sandbox is made up of a limited supply of LAND parcels that can be bought, owned, sold and traded by users (Madrid et al., 2020).

Figure 7: A snapshot from within The Sandbox environment (Forkast, 2021)

Figure 6: A map of The Sandbox (Fashionnetwork, 2022)

The Sandbox features three main products or tools that users have access to (Everyrealm, 2022):

- the VoxEdit, this tool allows users to create their own NFT's and ASSETS to use and sell in the Sandbox world;
- the Game Maker, which allows users to create their own items, buildings or games without the need for the ability to code;
- the Marketplace, the place where users can buy and sell their creations in the first two tools.

Though the Sandbox is not yet a fully decentralised virtual world, it showcases several other factors that are of great interest to metaverse spaces. The Game Maker that is featured in the Sandbox is an example of innovations that allow more and newer users to create in the metaverse. By removing the boundary of needing the ability to code, users who want to create spaces can now do so without having to invest as much time and effort.

Native cryptocurrency and other tokens

The native cryptocurrency in the Sandbox is SAND (Madrid et al., 2020). Transactions in the Sandbox can only be carried out by using SAND. The initial coin offering took place in 2020, in which the goal of reaching $3.000.000 was achieved. Currently SAND is trading at 1 SAND = $0,43[5], and it is highly subject to changes. Next to SAND, other assets are used in the Sandbox, each with their own specific role. These are ASSETS (models built and traded by users), GEMS (can be used to attribute values to ASSETS) and CATALYSTS (necessary to create ASSETS) (Madrid et al., 2020).

Technical workings

Similar to Decentraland, the Sandbox is made up of a limited supply of 166.464 non-fungible LAND parcels (Madrid et al., 2020). These LAND parcels can be bought, owned, rented, sold and traded by users. The Sandbox uses Ethereum as its substrate for its smart contract ledgers (Madrid et al., 2020), granting users full control over their own assets. The properties of each LAND in the Sandbox are recorded in this blockchain-based ledger, which includes a unique set of (x,y) coordinates, the owner, and the user's retention of copyright. These transactions can only be completed using the Sandbox' native currency, SAND, and are recorded in the same blockchain-based ledger when LAND is sold peer-to-peer (Madrid et al., 2020).

Governance

Governance of the Sandbox is currently shared between the owners and creators of the platform and its users, inching closer to full ownership and control by the Sandbox' users (the Sandbox, 2019). This is due to the platform being in an alpha development phase, and not fully launched. In simple terms, it is not yet a finished product. Once this is the case, full ownership and governance will be transferred to users of the platform (Madrid et al., 2020).

[5] Snapshot of SAND value, from https://coinmarketcap.com/currencies/the-sandbox/ on 5 January 2023

Next to SAND being the only currency in the Sandbox, it grants users the right and ability to participate in decision making in governance of the platform (Madrid et al., 2020). These rights can be exercised through a DAO-structure. In this structure, decisions are made on the allocation of grants by the Sandbox foundation.

Themes

The empirical findings are discussed per theme, starting with governance, followed by interaction, and expectations and predictions. First, a general overview of the findings per theme is posed using an occurrence table. In each table, we find a quantitative overview of how often certain topics have been discussed. Following each table, quoted and coded sections of text are discussed in depth and in relation to each other. Codes are discussed together when the data suggests a relation between codes (e.g. co-occurrence or high attributed importance).

1. Governance

Theme: Governance	*Occurrences*
~DAO~	13
Decentralised	8
Ownership	42
~Planning~	14
User power & agency	8
Web 3	2
Total	87

Table 7: theme Governance code occurrence table for The Sandbox

Decentralised

The Sandbox is created with the idea to give users a central position in the virtual environment. The aim is to give users power through a DAO, however, this DAO does not yet exist and is still under construction. It remains unclear how this DAO will be shaped and how users are empowered within this governance system. This means that the Sandbox is not yet decentralised, although this is the goal for the near future. Executive and governing power therefore still lies with the creators. A certain amount of centralized institutions remains necessary for the proper functioning of the Sandbox, such as API's (SB9).

"I hope that more and more people will realize that we cannot build the real metaverse if we keep like a very centralized mindset, and we only agree on [that] we need to build API's that are still controlled by companies and data that are not in the end of users […] But ultimately [we are] super laser focused on Creator-first, being user driven and that's the core value in web3. Web3 for me is user-centrally, community driven versus profit-centric or like trying to centralize all data" (SB9)

Ownership
The data shows that ownership is a focal point for The Sandbox's development. In The Sandbox, tools exist for users to create their own NFT's and spaces (SB11, SB13, SB15, SB19). It was found that this ownership is facilitated through blockchain technology and smart contracts. In this respect, users have agency over their own creations in The Sandbox, with an extended focus on copyright. However, the data did not show a connection between ownership and the DAO, and how control over The Sandbox on a governance level will practically be arranged.

"Sandbox states that its "mission is to build a gaming system where creators can craft, play, share, and trade without central control" while enjoying secure copyright ownership." (SB15)

2. Interaction

Theme: Interaction	*Occurrences*
Avatar	36
Community	51
~Enhancing accessibility~	2
Immersion	4
Persistence	3
Presence	3
~Spatial~	11
~Metaverse space design similar to physical world~	6
~Metaverse space design different from physical world~	3
~Public space~	4
Total	123

Table 8: theme interaction code occurrence table for The Sandbox

~Enhancing accessibility~
The Sandbox is found to be a host for human interaction in virtual spaces. During the Covid-19 pandemic, the space presented itself as a viable alternative for physically meeting.
"Faced with the impossibility of meeting in person, he narrates, they developed the Sandbox residence." (SB 4).

It was also found that the Sandbox wants to be accessible. One way of achieving this was by removing the barrier of coding, enabling easier creation within the Sandbox.

"the Sandbox also supports the creation of 3D games for free by using human-readable visual scripting tools." (SB3)

The Sandbox was found to draw on extensive similarities to physical space in its spatial design. For example, transportation systems in the Sandbox are compared do subway systems in the physical world.

Space design similar to physical world
It was found that in the Sandbox, spaces were designed by creators to be similar to physical spaces and to have a recognisable feel to them. Data on the Sandbox showed a connection between spatial environments and communities.
" they want to develop neighborhoods so that strong feeling of community proximity because we're in a spatial environment (SB9)

The data showed that when the creators of The Sandbox were considering transport of avatars through their environment, they did so following the example of a physical world system like a subway. The subway train was replaced by a teleportation system, and the subway station with a portal. Data showed that the creators wanted to bring people close to where they want to go, without directly bringing them to the 'front door', showing a consideration of how the creators wanted space to be used for interaction in the Sandbox (SB5, SB6, SB9). The creators wanted to actively encourage spontaneous human interaction by directing traffic past other people.

"Think of them like subway stations around the metaverse. [….] Think of the Portals as instant transportation into the hearts of these neighborhoods. It both gets you close to your destination, as well as encourages the kind of discovery serendipity that will build a strong community. After you drop into the right neighborhood, you can walk that last couple blocks to your final destination, just like a subway system in any large city." (SB6)

"Portals are a way to fast-travel across the metaverse of The Sandbox. Through these portals any point in the virtual world can be accessed. The Sandbox is trying to create neighborhoods, (SB5)

3. Expectations and predictions

Theme: Expectations and predictions	*Occurrences*
~Certainty about future of the metaverse~	0
~Uncertainty about future of the metaverse~	2
~Expectations~	16
~Metaverse as an extension to physical space~	2
~Negative attitude~	1
~Positive attitude~	5
Total	26

Table 9: theme expectations and predictions code occurrence table for The Sandbox

Expectations
It was found that The Sandbox is still in an alpha development phase, SB1 referred to The Sandbox as 'one of the most anticipated projects', indicating that the project is

not finished. This means that certain parts of the future of The Sandbox are unclear and uncertain, and thus remain guesswork.

"We expect a wide variety of audiences to enjoy gaming experiences (SB19)

"Depending who you ask, it's either the future or a whole bunch of hypotheticals" (SB18)

At the same time, positive expectations are pronounced by the data (SB10, SB19).

"More than a strict metaverse reflection of Hong Kong, Mega City is its expansion into the future, a place of dreams and fun. All LAND in Mega City will share this city-of-the-future connection that will be uniquely Hong Kong in its visual approach while reflecting the vision of individual LAND owners" (SB10).

4.3 Comparative results

It was found that articles discussing Decentraland provided more coding occurrences than The Sandbox. Table 10 shows the difference in occurrences.

Theme: Governance	*Decentraland*	*The Sandbox*
~DAO~	32	13
Decentralised	22	8
Ownership	19	42
~Planning~	31	14
User power & agency	16	8
Web 3	9	2
Total	**113**	**87**

Table 10: Code occurrence theme governance for both cases

Governance

DAO

The data showed that while Decentraland is governed through a DAO, The Sandbox is still developing this system of governance. This means that a comparison cannot be drawn between the contents and workings of each DAO. The DAO is a new institution for governing a type of community and space. For Decentraland, the data showed that decentralised blockchain technology is the main enabling factor of the Decentraland DAO. Without blockchain technology, decentralised ownership of digital assets is not possible. Lee et al. (2021) describe this as a key factor for people to gain agency in digital environments. This resonates with the data, which showed that *ownerships* in Decentraland was the connection to user agency and Voting Power, granting the user control over Decentraland. According to Thorpe (2017), spatial planners can present themselves as managers of this newly distributed power.

By implementing a DAO as a system of governance, for example, the need for centrally controlled institutions can be diminished. This serves as an example to Rieder (2012) in describing how technology has the ability to change institutions.

This new found user agency over their environment presents parallels to Healey's (1996) 'communicative turn'. A changing institution enables users to enter active discussion, where previously virtual worlds were controlled by platforms that were in centralised control, following a technical rationale of governance over their platforms (McKinsey, 2022; Healey, 1996). This 'communicative turn' towards decentralised power resonates with the removal of power asymmetry as discussed by Flyvbjerg (2003).

For The Sandbox the connection with power and control over the environment was not found, as ownership was connected to creations and copyright, instead of voting power and agency. The foundation for this was also found in decentralised blockchain technology.

Interaction

Immersion and presence

For both environments, it was found that the design of a virtual environment was seen as an important factor to the level of immersion and presence. In the literature, this connection was not as clear, with only Lee et al. (2021) mentioning realistic renders of a space as being of influence to the sense of immersion. Slater (2009) and Davis et al. (2009) ascribe the sense of immersion directly to technology such as image fidelity and improvements in VR glasses. This connection was not found in this dataset.

Theme: Interaction	*Decentraland*	*The Sandbox*
Avatar	33	36
Community	53	51
~Enhancing accessibility~	3	2
Immersion	16	4
Persistence	13	3
Presence	15	3
~Spatial~	4	11
~Metaverse space design similar to physical world~	3	6
~Metaverse space design different from physical world~	65	3
~Public space~	30	4
Total	**235**	**123**

Table 11: Code occurrence theme interaction for both cases

Interaction with space

In both cases empirical data showed that the degree to which a virtual space resembled physical spaces influenced the immersion users can feel. The theory did not present this, but showed a different side to immersion, namely that of the medium through which the virtual world presents itself to the user. In the theory, advancements in Head Mounted Displays and image fidelity in screens increased

immersion (Slater, 2009). So there is no connection to be made between the theory and the empirical data, other that the possibility that they both influence the feeling of immersion from two different directions.

A difference that was found was that Decentraland had streets, plaza's and squares, where The Sandbox had no such virtual space. The Sandbox found that they did not need public space, as users would allow other users to pass over their lands. In Decentraland however, public space is used differently. Instead of it being the means for getting from A to B, it redefines itself as a space to discover.

Expectations and predictions

The third theme that was distilled from the thematic analysis is expectations and predictions. Table 12 shows the code occurrences in this theme for both cases. The data showed that significant weight was being put on expectations of the outcome of the developments, especially for The Sandbox. SB18 identified this, stating that interpretations of this outcome range from certainty about it being the future, to is being purely hypothetical.
This is similar for Decentraland. There, sources that came from a background in the metaverse were more positive about developments than others. For example DC11 and DC15 discuss doubts about society in Decentraland, calling it a poorly designed video game (DC11), to raising ethical questions (DC15)

Theme: Expectations and predictions	*Decentraland*	*The Sandbox*
~Certainty about future of the metaverse~	4	0
~Uncertainty about future of the metaverse~	5	2
~Expectations~	24	16
~Metaverse as an extension to physical space~	8	2
~Negative attitude~	3	1
~Positive attitude~	9	5
Total	**53**	**26**

Table 12: Code occurrence theme expectations and predictions for both cases

5. Conclusion and discussion

5.1 Answers to sub questions and main RQ

To structure the conclusion, first answers are provided to the sub questions. These answers, together with a reflection on the hypothesis presented in section 2.6, work up to the answer to the main research question.

SQ1: What developments have taken place and are taking place in human interaction moving 'to' the internet?

The first key development was the creation of the blockchain protocol, known to the world as Bitcoin. This development was the first showcase in how the internet could be decentralised. Following this first development, different companies, multinational and start-ups have been creating virtual environments that are running on blockchain technology. Development is also taking place in other areas that are vital for human interaction in the internet. Connection to the virtual space is made through hardware, such as VR glasses. As this hardware improves, so does a person's sense of presence and immersion in a virtual environment.

SQ2: How do people experience interaction in and with virtual space in proto-metaverses?

From the case study the answer arose that people engage with virtual space similar to how they engage with each other in the physical world. Instead of person to person, this interaction is avatar to avatar. Next to this, spatial characteristics of virtual environments we extensively found in the data of the case studies. It could be concluded that the degree of resemblance of a virtual space combined with improved image fidelity in screens could improve a user's sense of immersion in Decentraland and the Sandbox. The direct influence of improved hardware such as VR glasses as presented by Lee et al. (2021) and Slater (2009) was not recognised in the data analysis.

SQ3: How is governance of space and place currently present in proto-metaverses?

The empirical research showed that in proto-metaverses, new types of governance institutions are created off the back of key technological developments. These new governance institutions are called Decentralised Autonomous Organisations. They make use of a person's ownership of their own virtual space to create a system where users can vote on issues that arise in the virtual world. Through this voting system they attribute a small group of people with temporary power to act on their behalf governing the virtual world, called the DAO committee. This process was found to be clear for Decentraland, but it remained vague for The Sandbox.
Governance theory describes that spatial planners can present themselves to manage this power, steering how institutions can be shaped, maintained, changed and created (Beunen & Patterson, 2019; Thorpe, 2017). In the case of Decentraland for example, this means that a planner can act with attributed power over the virtual world.

How this pans out over different virtual environments and the metaverse as a whole remains uncertain, but it is clear that the groundwork for well-considered governance institutions is laid.

The Main Research Question (MRQ): How can governance & planning theory contribute to the development of human interaction within virtual environments in the metaverse?

To answer the main research question, first the hypothesis is reflected upon. The hypothesis as presented in section 2.6 is as follows:

"The hypothesis is twofold; first, the cases under study will showcase that the internet is gaining spatial properties that allow people to interact within it and with it in a 3-dimensional environment. Second, because of fundamental technological developments in blockchain technology, new ways of governance of these spaces can be institutionalised, allowing for more democratic control over the internet and one's own digital assets."

To reflect on the first part of the hypothesis, sub question 2 provides an answer. The internet is gaining spatial properties in the metaverse, and these are ascribed an important role in the feeling of immersion in this space. This feeling of immersion is a basis for human interaction with each other and with the virtual world they are in. Sub question 3 provides the reasons to also largely accept the second part of the hypothesis. The study found that new governance structures can be built on the technological foundations provided by blockchain. In the case of Decentraland, governance through a Decentralised Autonomous Organisation (DAO) is already institutionalised. This increasers user agency over one's own digital assets and grants the power to vote on matters through the DAO.
However, small adjustments must be made to the hypothesis. That new forms of governance allow for more democratic control cannot be concluded. It allows for control that is not centralised, which does not necessarily imply a democracy. Next to this, any newfound control over the internet is not concluded.

To synthesise a closing answer to the research question: Governance theory can provide insight into how governing institutions are and can be shaped. Together with knowledge of blockchain system, these insights can aid in the creation of institutions that can act to improve human interaction by exercising planning control over virtual spaces, improving and maintaining them to facilitate interactions.

5.4 Contributions

Society

In the introduction, three drivers for research in to governance of spaces in the metaverse were presented, pragmatic, positive, and negative. Firstly, the pragmatic dimension. The metaverse has positioned itself as an alternative to physical space, that could provide a potential back up for when meeting in the physical world is not

possible. By creating persistent virtual worlds in the metaverse that are governed and maintained well, this position can be solidified.
Secondly, the metaverse and everything connected to it is constantly developing, this means that even until the last week of writing, interesting news came out about the cases in this research. With society progressing towards the metaverse, it is relevant to contribute to discussion on how to govern societies in the metaverse from an institutional point of view, as it could help guide the discussion positively. Next to this, providing safely governed virtual spaces to meet other people is a cornerstone to bringing people closer together in the metaverse.
Thirdly, by knowing that new technologies enable the creation of new governance structures for virtual spaces, it is possible for users to be actively involved in the system of governance. This new decentralised governance greatly diminishes any power a single centralised entity could try to enforce, which can greatly mitigate possible adverse outcomes of metaverse development.

Scholarship

This thesis has explored a previously unexplored possible addition to the realm of spatial planning and governance. First, by finding a connection between blockchain and spatial governance, this thesis adds spatial governance to metaverse research. With the conclusion that new technologies enable the creation of new institutions, this thesis can function as a stepping stone towards more research on the connection between blockchain technology and spatial governance.

6. Reflection & Recommendations

6.1 Reflecting on the results

The theoretical framework could have been improved by adding more literature on institutions and governance. However, I have made the deliberate choice to extensively describe the internet and its history, because I felt how unknown the metaverse and blockchain was and is to the planning realm.

A case study design proved adequate for the goal of this research. However, empirical data collection and analysis could be improved. Within the used methods, the data collection could have been more structured and more extensive. Because of this, there was a lot of repletion in the dataset. While repetition can be good, implicitly saying that many sources discuss it, based on their contents the data did not provide many different insights.

The collected data and outcome of this research provided me with sufficient insights to be able to answer the research questions. However, due to the similarity between the cases, generalisation of the outcomes proved difficult.

In the end I feel that I have contributed something new and previously unexplored to the spatial planning realm, hopefully raising many new interests and possible questions to answer in the future.

6.2 Improvements for the current work and recommendations for further research

This study focussed on two virtual worlds that were found to be similar in many respects. They were chosen deliberately, as they represent characteristics of proto-metaverses. However, a comparative study with a fundamentally different virtual space such as that of Meta Horizon, could shed more light on different governance styles. Drawing comparisons between centralised and decentralised virtual environments could provide insights on the impact governance style has on user agency and power over the environment, and what this in turns represents for human interaction.

Building on this, a comparative case study between a proto-metaverse and a space in the physical world could add to the understanding of the impact of technology on systems of governance.
Furthermore, it would be interesting to replicate this study in a few years to compare expectations found in this study with possible outcomes, and to see how the case of The Sandbox has developed from here.

6.3 Personal reflection on the research

The process of writing this thesis has proven challenging at times due to several reasons. First, because the subject is so new it was difficult to define a scope and direction. In the space between spatial planning and the metaverse there were undiscovered connections, but this was so broadly interpretable that setting boundaries proved hard.
For me, time planning and writing this thesis proved more difficult than I expected it at first. Together with the above, this has had an impact on my motivation. However, the more I got back into my thesis towards the end, the more I found interest in my topic. To such an extent that I plan to continue on following metaverse developments, and especially those concerning spatial design, closely.

I am grateful for the support that I had from my supervisor Dr. Christian Lamker, to help me get and stay on the right track.

7. References

Alexander, E. (2005). Institutional Transformation and Planning: From Institutionalization Theory to Institutional Design, Planning Theory, 4(3), pp. 209-223.

Andringa, C. (2022). Property of the future: A research into factors influencing the value of virtual land, Master Thesis, University of Groningen.

Ausopen (2021). AO launches into Metaverse, serves up world-first NFT art collection linked to live match data. Accessed on 19-10-2022, via https://ausopen.com/articles/news/ao-launches-metaverse-serves-world-first-nft-art-collection-linked-live-match-data.

Babri, S.E., Allam, Z. & Krogstie, J. (2022). The Metaverse as a virtual form of data-driven smart urbanism: platformization and its underlying processes, institutional dimensions, and disruptive impacts, Computational Urban Science, 2(24), pgnr. n/a.

Bailenson, J.N., Swinth, K., Hoyt, C. & Persky, S. (2005). The independent and interactive effects of embodied-agent appearance and behavior on self-report, cognitive and behavioural markers of copresence in immersive virtual environments. Presence: Teleoperators & Virtual Environments, 14(4), pp. 379-393.

Bainbridge, W.S. (2007). The scientific research potential of virtual worlds, Science Magazine, 317, pp. 472-476.

Ball, M. (2020). The Metaverse: What It Is, Where to Find it, Who Will Build It, and Fortnite. Accessed on 20-10-2022, via https://www.matthewball.vc/all/themetaverse.

Ball, M. (2022). The Metaverse. 1st Edition, Liveright, New York, USA.

Bartle, R. (2003). Designing Virtual Worlds. Edition unknown, Creative Commons.

Benedikt, M. (Ed.) (1991). Cyberspace: First Steps. 3rd Press, MIT Press, Cambridge, MA.

Benkler, Y. (2007). The Wealth of Networks: How Social Production Transforms Markets and Freedom.. Edition unknown, New Haven, CT: Yale.

Berners-Lee, T. (2000). Weaving the Web: The Past, Present and Future of the World Wide Web. Edition unknown, London: Texere.

Beunen, R. & Patterson, J. (2019). Analysing institutional change in environmental governance: exploring the concept of ‘instutitional work’, Journal of Environmental Planning and Management, 62(1), pp. 12-29.

Bloomberg Intelligence (2021a). The web 3 distributed metaverse with Ryan Gill [Podcast]. Accessed on 09-09-2022, via https://open.spotify.com/episode/5mUlXlmgrtpbe2yS6Z5J4O?si=484696e580b94989.

Bloomberg Intelligence (2021b). Building the metaverse with Marc Petit of Epic Games [Podcast]. Accessed on 1-11-2022, via

https://open.spotify.com/episode/1lNLWmjYzOYFFbDeRsHU1D?si=58ee7d13f4414c79.

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology., Qualitative Research in Psychology, 3, pp. 77-101.

Brownlee, M. (2022). Who Cares About the Metaverse? [Online video]. Accessed on 02-11-2022, via https://www.youtube.com/watch?v=CqkhjL3WvWQ.

Bryman, A. (2012). Social Research Methods. 4th Edition, Oxford, UK: Oxford University Press..

Buterin, V. (2022). Where to use a blockchain in non-financial applications?. Accessed on 25-10-2022, via https://vitalik.ca/general/2022/06/12/nonfin.html.

Cassidy, J. (2002). Dot-con: How America Lost Its Mind and Its Money in the Internet Era. Edition unknown, New York: Harper Collins..

Christidis, K. & Devetsikiotis, M. (2016). Blockchains and Smart Contracts for the Internet of Things, IEEE, 4, pp. 2292-2303.

Cimermanaite, A. (2023). Decentraland is hosting the first Metaverse Architecture and Design Biennale. Accessed on 08-01-2023, via https://mpost.io/decentraland-is-hosting-the-first-metaverse-architecture-and-design-biennale/.

Clifford, N., Cope, M., Gillespie, T. & French, S. (2016). Key Methods in Geography. 3rd Edition, London: Sage Publications Ltd..

Coinmarketcap (2023). The sandbox. Accessed on 05-01-2023, via https://coinmarketcap.com/currencies/the-sandbox/.

Davis, A., Murphy, J., Owens, D., Khazanchi, D. & Zigurs, I.(2009). Avatars, People, and Virtual Worlds: Foundations for Research in Metaverses, Journal of the Association for Information Systems, 10(2), pgnr. n/a.

De Roo, G. & Voogd, H. (2015). Abstracties van Planning. 1.ed, Cooperatie InPlanning U.A.

Decentraland (2021). Sotheby’s opens a virtual gallery in Decentraland. Accessed on 19-10-2022, via https://decentraland.org/blog/announcements/sotheby-s-opens-a-virtual-gallery-in-decentraland/.

Decentraland (2022). Decentraland . Accessed on 06-10-2022, via www.decentraland.org.

Decentraland (2023a). What is the DAO? . Accessed on 04-01-2023, via https://docs.decentraland.org/player/general/dao/overview/what-is-the-dao/.

Decentraland (2023b). How the DAO works. Accessed on 04-01-2023, via https://docs.decentraland.org/player/general/dao/overview/how-does-the-dao-work/.

Dixon, C. (2021). Why Web3 matters. Accessed on 15-12-2022, via https://future.com/why-web3-matters/.

Earth 2 (2022). Ideology, Approach & Phases. Accessed on 8-11-2022, via https://earth2.io/ideology-approach-phases.

Epic Games (2022). Fortnite. Accessed on 24-10-2022, via https://www.epicgames.com/fortnite/en-US/home.

Ethereum (2022a). Introduction to Web3. Accessed on 25-10-2022, via https://ethereum.org/en/web3/#web3.

Ethereum (2022b). Non-fungible tokens (NFT). Accessed on 25-10-2022, via https://ethereum.org/en/nft/.

Euronews (2021) Welcome to Decentraland, the metaverse world with its own crypto where 'land' is worth millions. Accessed on 17-01-2023 via https://www.euronews.com/next/2021/11/29/welcome-to-decentraland-the-metaverse-world-with-its-own-crypto-where-land-is-worth-millio

Everyrealm (2022). The Sandbox: From Mobile Game to Metaverse Leader. Accessed on 05-01-2023, via https://everyrealm.com/blog/education/the-sandbox-a-high-level-overview.

Fashionnetwork (2021). Metaverse: The Sandbox joins Arianee to create hybrid brand experiences. Accessed on 17-01-2023 via https://us.fashionnetwork.com/news/Metaverse-the-sandbox-joins-arianee-to-create-hybrid-brand-experiences,1394023.html#fashion-week-paris-men-ysl

Finney, A. (2022a). Zaha Hadid Architects designs virtual Liberland Metaverse city. Accessed on 8-11-2022, via https://www.dezeen.com/2022/03/11/liberland-metaverse-city-zaha-hadid-architects/.

Finney, A. (2022b). BIG designs virtual office in the metaverse for Vice Media Group. Accessed on 8-11-2022, via https://www.dezeen.com/2022/03/02/big-viceverse-metaverse-virtual-office-vice-media/.

Florian, M. (2022). Can public space be created in the metaverse? Accessed on 06-10-2022, via https://www.archdaily.com/987613/can-public-space-be-created-in-the-metaverse.

Flyvbjerg, B. (2003). Rationality and Power, In Campbell, S. and S. Fainstein (eds.) Readings in Planning Theory, pp. 318 - 329, Oxford (UK): Blackwell.

Flyvbjerg, B. (2006). Five misunderstandings about case study research, Qualitative inquiry, 12(2), pp. 219-245.

Forester, J. (1982). Planning in the Face of Power, Journal of the American Planning Association, , 48 (1), pp. 67-80.

Forkast (2021). The Sandbox NFT metaverse platform raises $93M in Series B led by SoftBank. Accessed on 17-01-2023 via https://forkast.news/the-sandbox-nft-metaverse-platform-series-b/

Given, L.M. (Ed.) (2008). The SAGE Encyclopedia of Qualitative Research Methods. Edition unknown, London: Sage Publications.

Greenbaum, D. (2022). The virtual worlds of the metaverse Accessed on , via https://www.science.org/doi/full/10.1126/science.add5905.

Guadagno, R. E., Blascovich, J., Bailenson, J.N. & McCall, C. (2007). Virtual humans and persuasion: The effects of agency and behavioral realism, Media Psychology , 10(1), pp. 1-22.

Harvey, D. (2008). Right to the City, New Left Review, 53, pp. 23-40.

Healey, P. (1996). The communicative turn in planning theory and its implications for spatial transformation, Environment and Planning B: Planning and Design, 23, pp. 217-234.

icodrops.com (2023). Decentraland (VR). Accessed on 03-01-2023, via https://icodrops.com/decentraland/.

Kaefer, F., Roper, J. & Sinha, P.N. (2015). A software-assisted qualitative content analysis of news articles: Examples and reflections., Qualitative Social Research,, 16(2), .

Ketchum III, W.E. (2020). Fortnite's Travis Scott concert was historic. But he's not the only artist getting creative.. Accessed on 06-12-2022, via https://www.nbcnews.com/think/opinion/fortnite-s-travis-scott-concert-was-historic-he-s-not-ncna1195686.

Kim, I. & Kuljis, J. (2010). Applying Content Analysis to Web-based Content, Journal of Computing and Information Technology, 18(4), pp. 369-375.

Kumar, S., Chhugani, J., Kim, C., Kim, D.H., Nguyen, A., Dubey, P., Bienia, C. & Kim, Y.M.(2008). Second Life and the new generation of virtual worlds, Computer, 41(9), pp. 46-....

Lee, L-H., Braud, T., Zhou, P., Wang, L., Xu, D., Lin, Z., Kumar, A., Bermejo, C. & Hui, P. (2021). All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda, Computers and Society, 14(8).

Leiner, B.M., Cerf, V.G, Clark, D.D., Kahn, R.E., Kleinrock, L., Lynch, D.C., Postel, J., Roberts, L.G. & Wolff, S. (2009). A Brief History of the Internet, ACM SIGCOMM Computer Communication Review, 39(5), pp. 22-31.

Lewins, A. & Silver, C. (2007). Using Software in Qualitative Research: A Step-by-Step Guide. Edition unknown, London: Sage Publications.

Liberland (2022). Free Republic of Liberland. Accessed on 8-11-2022, via https://liberland.org/en/about.

Linden Lab (2022). Second Life. Accessed on 25-10-2022, via https://secondlife.com/.

Lodge, M. (2022). What is Decentraland? . Accessed on 03-01-2023, via https://www.investopedia.com/what-is-decentraland-

6827259#:~:text=Decentraland%20is%20a%203%2DD,wearables%2C%20socialize%2C%20and%20interact..

Lu Q., Xie X., Parlikad A.K., Heaton J. & Schooling J.(2020). From BIM towards digital twin: Strategy and future development for smart asset management, SERVICE ORIENTED, HOLONIC AND MULTI-AGENT MANUFACTURING SYSTEMS FOR INDUSTRY OF THE FUTURE, 853, pp. 392-404.

Madrid, A., Borget, S., Santurio, M., Iglesias, P. & Shrewsbury, L. (2020). The Whitepaper. Accessed on 05-01-2023, via https://installers.sandbox.game/The_Sandbox_Whitepaper_2020.pdf.

Maguire, M. & Delahunt, Brid. (2017). Doing a Thematic Analysis: A Practical, Step-by-Step Guide for Learning and Teaching Scholars., AISHE-J, Dundalk Institute of Technology, Vol. unknown, no. 3, pgnr. n/a.

Mayring, P. (2000). Qualitative Content Analysis, Forum Qualitative Sozialforschung, 1(2), .

McKinsey & Company. (2022). Value creation in the Metaverse. McKinsey & Company.

Meta Platforms (2021). Introducing Meta: A Social Technology Company. Accessed on 19-10-2022, via https://about.fb.com/news/2021/10/facebook-company-is-now-meta/.

Meta Platforms (2022). Introducing the Meta Avatars Store. Accessed on 25-10-2022, via https://about.fb.com/news/2022/06/introducing-the-meta-avatars-store/.

Microsoft (2022). Minecraft. Accessed on 24-10-2022, via https://www.minecraft.net/nl-nl.

Miles, M.B. & Huberman, M.A. (1994). Qualitative Data Analysis: An Expanded Sourcebook. 2nd Edition, Thousand Oaks: Sage Publications.

Morgan, D.L. (1993). Qualitative Content Analysis: A Guide to Paths not Taken, Qualitative Health Research, 3(1), pp.112–121.

Mystakidis, S. (2022). Metaverse, Encyclopedia, 2(1), pp. 486-497.

Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System. Accessed on 24-10-2022, via https://bitcoin.org/bitcoin.pdf.

Naughton, J. (2016). The evolution of the Internet: from military experiment to General Purpose Technology, Journal of Cyber Policy, 1(1), pp. 5-28.

Nawari, N.O. (2020). Blockchain Technologies: Hyperledger Fabric in BIM Work Processes, In: Toledo Santos, E., Scheer, S. (eds) Proceedings of the 18th International Conference on Computing in Civil and Building Engineering. ICCCBE 2020. Lecture Notes in Civil Engineering, 98, Springer.

NFT Now (2022). Decentraland: The Ultimate Game for Your Virtual Land Hustle. Accessed on 17-01-2023 https://nftnow.com/guides/decentraland-the-ultimate-game-for-your-virtual-land-hustle/

O'Reilly, T. (2005). What Is Web 2.0. Accessed on 24-10-2022, via https://www.oreilly.com/pub/a/web2/archive/what-is-web-20.html.

Ordano, E., Meilich, A., Jardi, Y. & Aroaz, M. (2018). Decentraland White Paper. Accessed on 15-12-2022, via https://decentraland.org/whitepaper.pdf.

Orel, M. & Guna, J. (2018). Decentralising virtual reality, Elektrotehniski Vestnik/Electrotechnical Review, 85, pp. 271-278.

Papagiannidis, S., Bourlakis, M. & Li, F. (2008). Making real money in virtual worlds: MMORPGs and emerging business opportunities, challenges and ethical implications in metaverses, Technological Forecasting and Social Change, 75(5), pp. 61-622.

Parisi, T.(2021). the seven rules of the metaverse. Accessed on 05-01-2021, via https://medium.com/meta-verses/the-seven-rules-of-the-metaverse-7d4e06fa864c.

Patton, M.Q.(2002). Qualitative research and evaluation methods. 3rd Edition, Thousand Oaks, CA: Sage Publications.

Polit, D.F. and Beck, C.T. (2010). Essentials of nursing research: Appraising evidence for nursing practice. 7th Edition, Philadelphia: Wolters Kluwer.

Putzier, K. (2021). Metaverse Real Estate Piles Up Record Sales in Sandbox and Other Virtual Realms. Accessed on 19-10-2022, via https://www.wsj.com/articles/metaverse-real-estate-piles-up-record-sales-in-sandbox-and-other-virtual-realms-11638268380.

Rapuano, M., Ferrara, A., Sbordone, F.L., Iachini, T., Ruotolo, F. & Ruggiero, G. (2020). The appearance of the avatar can enhance the sense of co-presence during virtual interactions with users, CEUR Workshop Proceedings 2730, conference paper, 2nd Symposium of Psychology-Based Technologies, PSYCHOBIT 2020.

Ready Player Me (2022). Ready Player Me. Accessed on 7-12-2022, via https://docs.readyplayer.me/ready-player-me/.

Ready Player One (2018). [Film] Directed by Stephen Spielberg(2018). Ready Player One. , Warner Bros., USA.

Rheingold, H. (1991). Virtual reality. 1st Edition, Simon & Schuster, New York.

Rieder, B. (2012). Institutionalizing without Institutions? Web 2.0 and the Conundrum of Democracy, In Massit-Folléa, F., Méadel, C., & Monnoyer-Smith, L. (Eds.), Normative Experience in Internet Politics, pgnr. n/a, Presses des Mines.

Roblox (2022). Reimagining the way people come together. Accessed on 24-10-2022, via https://corp.roblox.com/.

Rockstar Games (2022). Grand Theft Auto Online. Accessed on 44902, via https://www.rockstargames.com/gta-online.

Salet, W. (2018). Five Paradigms of Institutional Planning, In: Public Norms and Aspirations, pp. 93-132, New York:Routledge.

Schumacher, P. (2022). The Metaverse as Opportunity for Architecture and Society: Design Drivers and Core Competencies, Architectural Intelligence, .

Searle, J. R. (2005). What is an institution?, Journal of Insttutional Economics, 1(1), pp. 1-22.

Shi, W., Goodchild, M., Batty, M., Li, Q., Liu, X. & Zhang, A. (2022). Prospective for urban informatics, Urban Informatics, 1(2), pgnr. n/a.

Slater, M. (2009). Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments, Phil. Trans. R. Soc. B, 364, pp. 3549–3557.

Smart, J., Jamais, C. & Paffendorf, J. (2008). Metaverse Roadmap: Pathways to the 3D Web. A Cross-Industry Public Foresight Project. Accessed on 23-09-2022, via https://www.w3.org/2008/WebVideo/Annotations/wiki/images/1/19/MetaverseRoadmapOverview.pdf.

Souza, V., Maciel, A., Nedel, L. & Kopper, R. (2022). Measuring Presence in Virtual Environments: A Survey, ACM Computing Surveys, 54(8), pgnr. n/a.

Stake, R. (2005). The art of case study research. Edition unknown, London: Sage Publications Ltd..

Stephenson, N. (1992). Snow Crash. 1st Edition, Bantam Books, New York.

Taylor, L. (2016). Case Study Methodology, In N. Clifford, M. Cope, T. Gillespie & S. French (Ed.) Key Methods in Geography, pp. 581-595, London: Sage Publications Ltd..

Terra, C. (2022). Tommy Hilfiger toont Spring 2022 collectie tijdens Metaverse Fashion Week. Accessed on 20-10-2022, via https://fashionunited.nl/nieuws/mode/tommy-hilfiger-toont-spring-2022-collectie-tijdens-metaverse-fashion-week/2022032253002.

The Matrix (1999). [Film] Directed by Lana & Lilly Wachowski (1999). The Matrix. Warner Bros., USA.

the Sandbox (2019). The evolution of the Sandbox. Accessed on 05-01-2023, via https://medium.com/sandbox-game/the-evolution-of-the-sandbox-762f0023349.

the Sandbox (2022a). The Sandbox. Accessed on 19-10-2022, via https://www.sandbox.game/en/about/.

the Sandbox (2022b). About The Sandbox Team. Accessed on 05-01-2023, via https://sandboxgame.gitbook.io/the-sandbox/other/about-the-sandbox-team.

Van Assche, K., Duineveld, M. & Beunen, R. (2014). Power and contingency in planning, Environment and Planning A, 46, pp. 2385-2400.

Wang, F. Y., Qin, R., Wang, X., & Hu, B. (2022). Metasocieties in metaverse: metaeconomics and metamanagement for metaenterprises and metacities., IEEE Transactions on Computational Social Systems, 9(1), pp. 2-7.

Yasin, C., Petri, I. & Barati, M. (2023). Blockchain supported BIM data provenance for construction projects, Computers in Industry, 144, pgnr. n/a.

Yin, R.K. (2018) . Case study research and methodology. 6th Edition, Los Angeles: Sage.

Zhan, Y., Xiong, Y. & Xing, X. (2023). A conceptual model and case study of blockchain-enabled social media platform, Technovation, 119, pgnr. n/a.

8. Appendices

Appendix A: Data sources thematic analysis

Article code	Title	Date written	Year	Date Accessed	Author	Hyperlink
DC1	*[VIDEO] Lecture/seminar for the Friedrich Naumann Foundation for Freedom, Potsdam*	04-03-2022	2022	05-01-2023	Schumacher, P.	https://www.youtube.com/watch?v=ipphmeTHFi8
DC2	*Decentraland Now Allows LAND Owners to Rent their Metaverse Spaces*	08-12-2022	2022	05-01-2023	Cryptoflies	https://blog.cryptoflies.com/decentraland-now-allows-land-owners-to-rent-their-metaverse-spaces/
DC3	*In the metaverse, you can basically do anything you want, so why does it all look much like our normal world, ask Luke Pearson and Sandra Youkhana*	08-04-2022	2022	05-01-2023	Pearson, L. & Youkhana, S.	https://advance-lexis-com.proxy-ub.rug.nl/document/?pdmfid=1516831&crid=7f45dacc-68cd-485b-adc1-4b6a03085af5&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A655T-00M1-DY4H-K4DW-00000-00&pdcontentcomponentid=382507&pdteaserkey=sr6&pditab=allpods&ecomp=zznyk&earg=sr6&prid=98efc5e3-3934-4f76-ab92-471736d9a5c2
DC4	*Roar Opening Meta Space Studio, An Architecture And Design Service, Within Decentraland*	07-02-2022	2022	05-01-2023	Muhammad, I.	https://www.beyondgames.biz/19505/roar-opening-meta-space-studio-an-architecture-and-design-service-within-decentraland/
DC5	*Decentraland: A Pioneer in the Open Metaverse Category*	25-06-2022	2022	05-01-2023	Everyrealm	https://everyrealm.com/blog/education/decentraland-a-high-level-overview
DC6	*Can public space be created in the metaverse?*	24-08-2022	2022	05-01-2023	Florian, M.C.	https://www.archdaily.com/987613/can-public-space-be-created-in-the-metaverse?ad_source=search&ad_medium=projects_tab&ad_source=search&ad_medium=search_result_all
DC7	*Designing Genesis City: Roads & Urban Planning*	26-02-2018	2018	05-01-2023	Waldorf, T.	https://decentraland.org/blog/platform/designing-genesis-city-roads-urban-planning/?utm_medium=website&utm_source=archdaily.com
DC8	*The Metaverse in Practice: How to Build in the Digital Space*	03-12-2022	2022	05-01-2023	Ghisleni, C.	https://www.archdaily.com/989214/the-metaverse-in-practice-how-to-build-in-the-digital-space?ad_source=search&ad_medium=projects_tab&ad_source=search&ad_medium=search_result_all
DC9	*Do companies need a metaverse voting policy?*	01-11-2022	2022	05-01-2023	Holland & Knight LLP	https://advance-lexis-com.proxy-ub.rug.nl/document/?pdmfid=15168

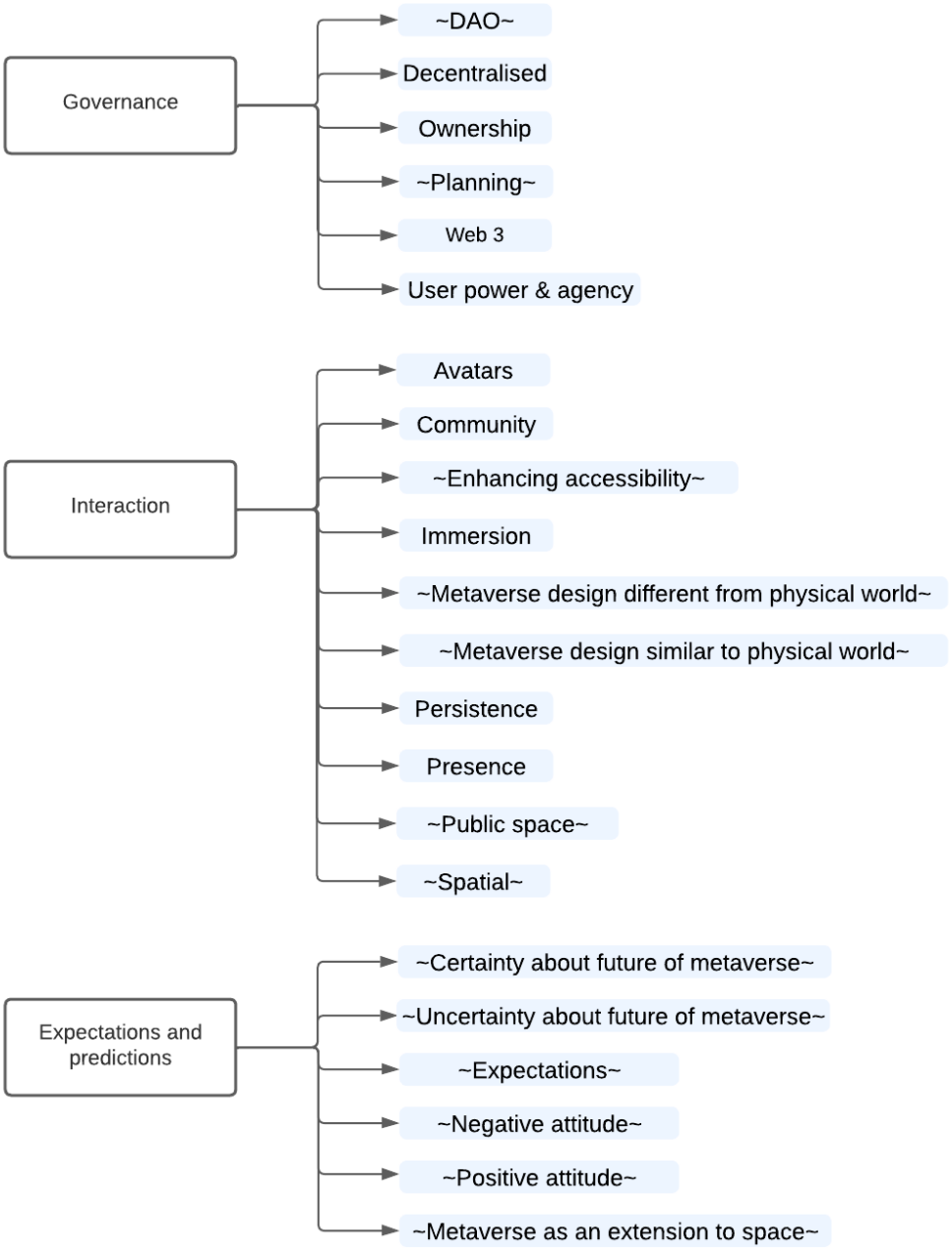
						31&crid=d7f6ab08-1342-4032-86a3-6137800ce6e5&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A66S5-DTM1-JCMN-Y289-00000-00&pdcontentcomponentid=299488&pdteaserkey=sr26&pditab=allpods&ecomp=zznyk&earg=sr26&prid=9fcb0973-eba0-4ea8-b97c-7489042cf9a1
DC10	*New York, Paris, Milan, Decentraland; Global Fashion Goes Virtual with the World's Biggest Metaverse Fashion Week to Date*	24-02-2022	2022	05-01-2023	Thomson Reuters ONE	https://advance-lexis-com.proxy-ub.rug.nl/document/?pdmfid=151683 1&crid=ce26f5d1-d356-4c02-bcf1-57f9c1fcad33&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A64VS-0NF1-JC8H-G0G1-00000-00&pdcontentcomponentid=263816&pdteaserkey=sr7&pditab=allpods&ecomp=zznyk&earg=sr7&prid=4090238c-4c57-4d32-b71b-a3bcfd63352d
DC11	*Metaverse? It's just a poor video game*	09-03-2022	2022	05-01-2023	Faber, T.	https://advance-lexis-com.proxy-ub.rug.nl/document/?pdmfid=151683 1&crid=c31d9759-9797-48f6-9854-d5a1b5117d41&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A64YD-2GB1-JCBW-N0MY-00000-00&pdcontentcomponentid=293847&pdteaserkey=sr5&pditab=allpods&ecomp=zznyk&earg=sr5&prid=be418311-5cee-4553-92ca-adf506353892
DC12	*Metaverse Fashion Week Returns In Spring 2023 To Highlight Advances In Digital Fashion & Interoperability*	06-12-2022	2022	05-01-2022	MENAFN	https://advance-lexis-com.proxy-ub.rug.nl/document/?pdmfid=151683 1&crid=e26ec209-b832-442a-b736-1d062b014499&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A671F-0KK1-JBR8-B0HN-00000-00&pdcontentcomponentid=473845&pdteaserkey=sr3&pditab=allpods&ecomp=zznyk&earg=sr3&prid=1b82c8f5-f594-4b5c-9705-e83402f2ff37
DC13	*Opportunities And Legal Implications In The Metaverse*	07-01-2022	2022	05-01-2023	Ropes & Gray LLP	https://advance-lexis-com.proxy-ub.rug.nl/api/permalink/2e1d1e6e-e87d-4e88-8f85-f0d2a842cad8/?context=1516831
DC14	*The open road to the metaverse*	25-06-2022	2022	05-01-2023	Pandit, K.	https://advance-lexis-com.proxy-ub.rug.nl/document/?pdmfid=151683 1&crid=19ebddcd-dc00-4e21-

						a0e2-1d71a12e067e&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A65SB-KF01-DYX4-036C-00000-00&pdcontentcomponentid=11432&pdteaserkey=sr21&pditab=allpods&ecomp=zznyk&earg=sr21&prid=04744f1a-ea80-4583-9c80-83efaf269222
DC15	*Cities and the metaverse*	2022	2022	05-01-2023	National League of Cities	https://www.nlc.org/wp-content/uploads/2022/04/CS-Cities-and-the-Metaverse_v4-Final-1.pdf
DC16	*Metaverse and the shifting notions of public spaces*	27-04-2022	2022	05-01-2023	Borgohain, A.	https://urbandesignlab.in/metaverse-and-the-shifting-notions-of-public-spaces/
DC17	*Decentraland*	12-2021	2021	05-01-2023	Grider, D.	https://grayscale.com/wp-content/uploads/2021/12/Grayscale-Decentraland.pdf
DC18	*Decentraland: The Metaverse's Early Mover*	09-01-2022	2022	05-01-2023	Gabriele, M.	https://www.generalist.com/briefing/decentraland
DC19	*Decentraland LAND - What drives long term value*	25-2-2020	2020	05-01-2023	Decentral Games	https://decentral.games/blog/decentraland-land-what-drives-long-term-value
DC20	*Decentraland Whitepaper*	2018	2018	05-01-2023	Ordano et al.	
SB 1	*What is The Sandbox? The Ethereum NFT Metaverse Game*	27-04-2022	2022	06-01-2023	Hayward, A.	https://decrypt.co/resources/what-is-the-sandbox-the-ethereum-nft-metaverse-game
SB 2	*Gucci Opens Its Land In The Sandbox To The Public*	28-10-2022	2022	06-01-2023	Ellis, J.	https://nftevening.com/gucci-opens-its-land-in-the-sandbox-to-the-public/
SB 3	*Know Everything About Sandbox Metaverse*	31-01-2022	2022	06-01-2023	Weston, G.	https://101blockchains.com/sandbox-metaverse/
SB 4	*History and present, in the virtual; Tania Candiani*	21-11-2020	2020	06-01-2023	CE Noticias Financieras English	https://advance-lexis-com.proxy-ub.rug.nl/document/?pdmfid=151683 1&crid=58ab1d99-6c65-4fb2-8108-e8ef0b83dc6b&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A61BT-PS21-DY1R-B4DP-00000-00&pdcontentcomponentid=443607&pdteaserkey=sr8&pditab=allpods&ecomp=zznyk&earg=sr8&prid=c81d2369-c687-41db-9ada-7690b0cd158e
SB 5	*The Sandbox Reveals How To Travel Through Their World*	17-06-2020	2020	06-01-2023	Hoogendoorn, R.	https://www.playtoearn.online/2020/07/17/the-sandbox-reveals-how-to-travel-through-their-world/
SB 6	*Introducing: The Sandbox Transportation system*	16-06-2020	2020 a	06-01-2023	the Sandbox	https://medium.com/sandbox-game/introducing-the-sandbox-transportation-system-3f03bdab1059

SB 7	*Animoca Brands subsidiary The Sandbox partners with Webhelp to design metaverse community engagement*	26-05-2022	2022	06-01-2023	Joseph, E.	https://advance-lexis-com.proxy-ub.rug.nl/document/?pdmfid=151683 1&crid=41e25736-eab0-4f7b-a6ea-1d3f44b1addd&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A65J3-6GX1-JBYR-J35D-00000-00&pdcontentcomponentid=475330&pdteaserkey=sr0&pditab=allpods&ecomp=zznyk&earg=sr0&prid=4632e402-1d3b-4581-9760-c810e97dff3b
SB 8	*The Sandbox and Wunderman Thompson join forces to develop new experiences in the metaverse*	17-12-2022	2022	06-01-2023	ArabAd	https://advance-lexis-com.proxy-ub.rug.nl/document/?pdmfid=151683 1&crid=b4c24544-2bd6-436a-bd27-6b8b90c36d71&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A674C-SNC1-JDJN-6437-00000-00&pdcontentcomponentid=411362&pdteaserkey=sr4&pditab=allpods&ecomp=zznyk&earg=sr4&prid=4632e402-1d3b-4581-9760-c810e97dff3b
SB 9	*[VIDEO] Slush 2022 - Fireside Chat Between Sebastien Borget (The Sandbox) and Timmu Toke (Ready Player Me)*	17-11-2022	2022	06-01-2023	Borget, S.	https://www.youtube.com/watch?v=-XPXOBiTDWg
SB 10	*The Sandbox Announces Multiple Hong Kong Partnerships to Create Mega City in the Metaverse*	05-01-2022	2022	06-01-2023	Cheng, A.	https://www.animocabrands.com/the-sandbox-announces-multiple-hong-kong-partnerships-to-create-mega-city-in-the-metaverse
SB 11	*The Sandbox sells $1.66M of virtual land for its metaverse*	20-12-2022	2022	06-01-2023	Takahashi, D.	https://venturebeat.com/games/the-sandbox-sells-1-66m-of-virtual-land-for-its-metaverse/
SB 12	*What is The Sandbox Alpha Season 3?*	11-06-2022	2022	06-01-2023	Moreland, K.	https://www.ledger.com/academy/what-is-the-sandbox-alpha-season-3
SB 13	*The Sandbox Metaverse Hits 2M Users — K-Pop Partnership Underway*	07-03-2022	2022	06-01-2023	Say, N.	https://blockonomi.com/the-sandbox-metaverse-hits-2m-users-k-pop-partnership-underway/
SB 14	*Animoca Brands' Sandbox unveils Mega City 2 cultural hub; to propel Hong Kong metaverse*	26-04-2022	2022	06-01-2023	Proactive	https://www.proactiveinvestors.com.au/companies/news/980505/animoca-brands-sandbox-unveils-mega-city-2-cultural-hub-to-propel-hong-kong-metaverse-980505.html
SB 15	*Sandbox vs. Decentraland [2022]: Metaverses Come in Different Sizes*	13-10-2022	2022	06-01-2023	Marquit, M.	https://finance.yahoo.com/news/sandbox-vs-decentraland-2022-metaverses-151533668.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAAWPoXXiLY9X8Yhmx2pgJ5OJFf5Bh5NEaxisvtyXm8VUhEZ

						tjYbwPUi9hpamu5DmXNZpjj_9kcXDVPUSM7jL8ELQQERhdz_WItsIIsPSJIbV9nDw1L4lMe1Exdv_Oy7xeJ4oYiEorJvxn3iXJc_xGkR3Hz-4Pp_l_JwlkHSkhvYx#:~:text=Sandbox%20has%20a%20more%20specific,user%2Dgenerated%20content%20and%20art.
SB 16	*Transportation and portals*	2020	2020 b	06-01-2023	The Sandbox	https://sandboxgame.gitbook.io/the-sandbox/land/general-faq-land/transportation-and-portals
SB 17	*The Sandbox opens new virtual neighborhoods with three LAND sales*	22-11-2022	2022	06-01-2023	The Sandbox	https://medium.com/sandbox-game/the-sandbox-opens-new-virtual-neighborhoods-themed-around-14-major-brand-partners-with-two-land-4174ef86cff0
SB 18	*[VIDEO] These Architects are Building the Metaverse*	15-03-2022	2022	05-01-2023	Mills, F. & MacAree, G.	https://www.youtube.com/watch?v=tc_ofY5WFw8
SB 19	*The Sandbox whitepaper*	2020	2020	06-01-2023	Madrid et al.	

Appendix B: Code Book



Code book, by author. Tildes (~) indicate inductive codes.