The metaverse meets Web3:
the state of convergence in the UK

A Digital Catapult report
July 2023

Authors:

Dr Aki Jarvinen,
Lead Technologist, Immersive, Digital Catapult

Andrei Baloiu,
DLT/Blockchain Technologist, Digital Catapult

Dr Victoria Williams,
Senior Policy, Research & Engagement Manager,
Digital Catapult

Contents

Document User Guide

$\wedge$ Start of section

$\langle$ Previous page

$\equiv$ Contents page

$\rangle$ Next page

Executive summary

Executive summary

―――――

Over the course of the last 12-18 months, immersive experiences, visualisation, gaming, fashion, and virtual goods have evolved into a broader global ambition to build *the metaverse*.

―――――

Yet a significant change in how people access and use online services will not come simply through increased adoption of virtual reality headsets or augmented reality glasses. Real change will emerge when, and if, immersive applications converge with deep technologies with the potential to disrupt existing centralised platforms and their business models.

The UK government has recently laid out its ambitions to harness innovation in cyber-physical infrastructure (CPI). The vision is to enable transformation and harness the growth of convergent systems by leveraging Web3 and metaverse technologies (such as blockchain and immersive human-computer interfaces). This report looks at the state of UK industry in areas of metaverse-Web3 convergence, and how companies in the UK are exploring opportunities and perceiving the risks involved.

We have created this metaverse-Web3 convergence model based on metaverse and Web3 principles that can be used to identify the individual principles of a product, service or technology, and what types of business and user needs it might enable.

METAVERSE

Networked and data-driven

Content, asset and service-driven

Immersive and social

User-centred and empowering

GENERAL SPECIFIC CONVERGENCE SPECIFIC GENERAL

Decentralised and secure

Trustless

Public and permissionless

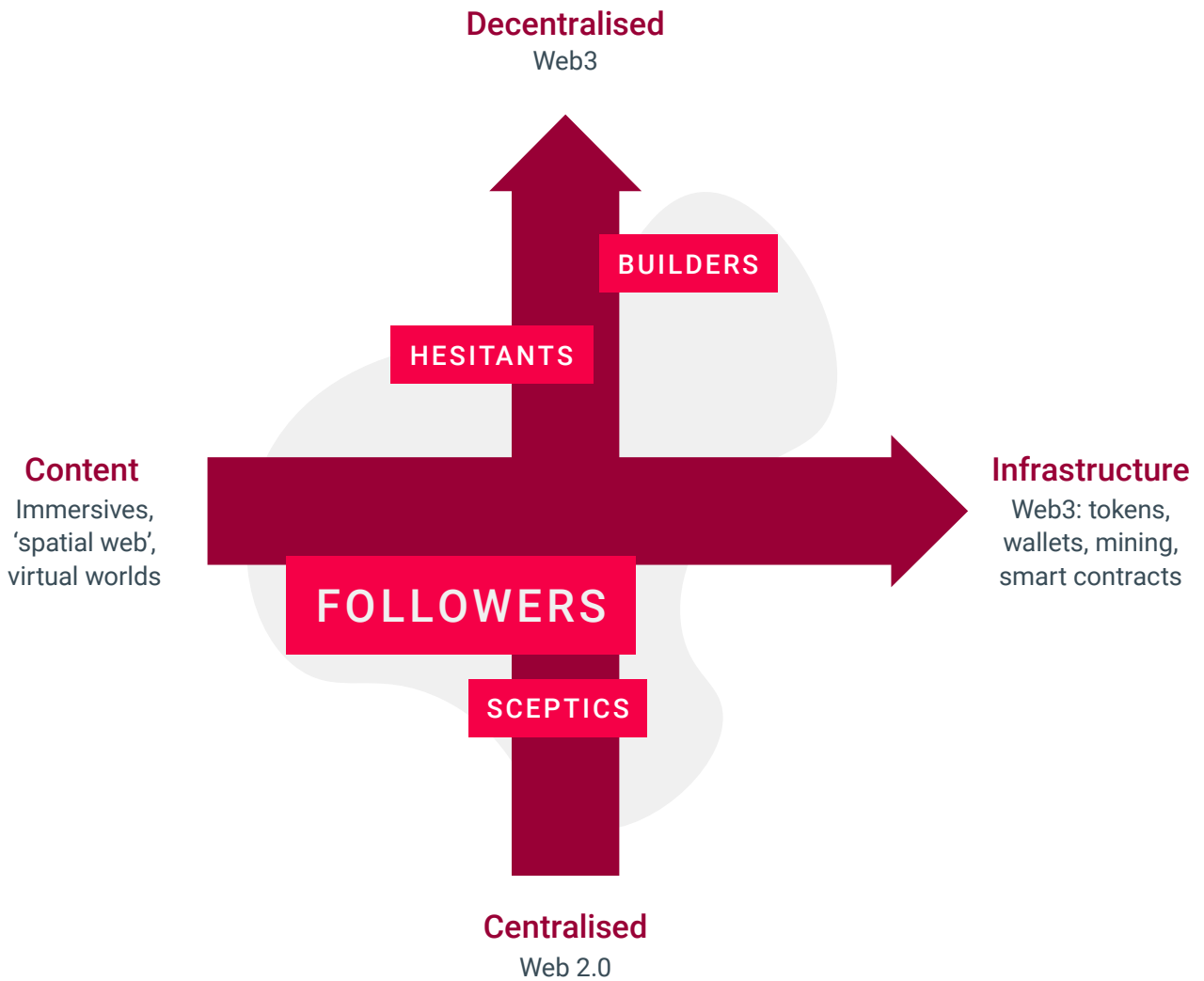Creating value through digital assets
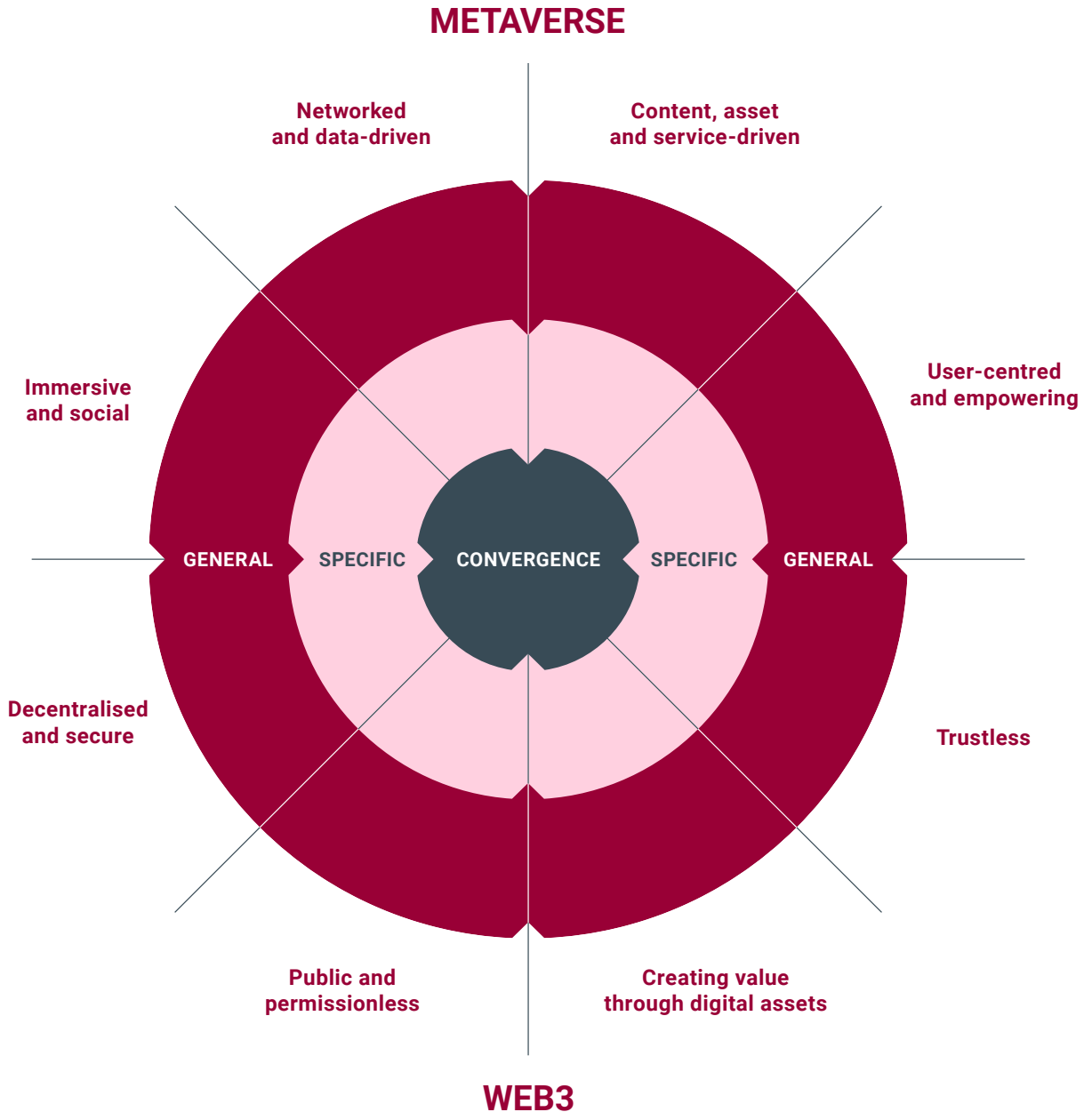
WEB3

In a series of study workshops, we used the metaverse-Web3 model to identify participant sentiment and uncover perceived convergence blockers. We also used the model as a tool to pinpoint the individual principles of a product, service or technology, and the types of business and user needs it might enable.

Overall, we found that participants perceive Web3 as the more coherent field, with a handful of concepts showing prominence: blockchain, decentralisation, cryptocurrencies and ownership. There were also mentions of NFT, AI, and openness, as well as expressions of scepticism. The metaverse results were found to be more fragmented, validating the vagueness that persists around the term. It was made clear, however, that the metaverse is perceived as immersive, accessed via VR, an opportunity, connected and collaborative - while also being seen as confusing, undefined, and a hyped pipe dream.

High level summary of perceived convergence blockers:

- Immaturity of legislation

- Legacy issues with government support

- Perceived volatility

- Lack of reliable and skilled workforce for hire

- Integrating new revenue models with existing walled gardens

- The general state of the ecosystem and market

- Lack of established terminology and focus

We then mapped the current state of play of Web3 and metaverse convergence, using four distinct segments we found within our research community of UK companies.

Decentralised
Web3

BUILDERS

HESITANTS

Content
Immersives, 'spatial web', virtual worlds

Infrastructure
Web3: tokens, wallets, mining, smart contracts

FOLLOWERS

SCEPTICS

Centralised
Web 2.0

- **Builders** are actively building towards the metaverse and/or Web3 promises

- **Hesitants** tend to work on related fields, but are held back by the risks related to legislation and lack of investment or skills

- **Sceptics** doubt that the technologies are an improvement to existing solutions, have not found use cases, or consider the technologies or principles fraudulent

- **Followers** will adopt metaverse or Web3 technologies if clients or peers do so

In summary:

- Technologists and businesses building the metaverse and Web3 need to strive for high interoperability, otherwise the improvements that Web3 promises will be incremental at best

- Facilitating collaboration between Builders and Hesitants has the potential to put both cohorts in a better position to succeed

- We encourage hypotheses on product and service market fit, and suggest that the highest reach with most impact is found in concepts with the greatest convergence

For the UK to be a leader in CPI and convergent technologies, further national and international collaboration is key. We need a healthier tech ecosystem that fosters better connection between supply and demand of the underpinning technologies, reducing risk for the end user. We also need proven business models that encourage more innovators to get involved, not just current big tech and global luxury brands.

Introduction

- The vision for cyber-physical infrastructure in the UK

- Cyber-physical infrastructure, the metaverse, and Web3

- Our research

Introduction

The vision for cyber-physical infrastructure in the UK

———

The research documented in this report is positioned under the UK government's vision for cyber-physical infrastructure (CPI): infrastructure that facilitates the convergence of physical and digital environments and assets.

———

CPI underpins a range of cyber-physical systems, or advanced computer systems that facilitate new interactions between physical and digital environments. The convergence of multiple technologies that are interconnected and interoperable is of particular importance to the vision presented by CPI.

The UK government has laid out its ambitions to harness innovation in cyber-physical infrastructure, pursuing a responsible and resilient approach that will drive systems optimisation, enable transformation to support net zero ambitions, and harness the growth of convergent systems — from digital twins and the 'industrial metaverse' to robotics and autonomous systems.

Digital Catapult has worked closely with the Department for Business, Energy and Industrial Strategy (now part of the Department for Science Innovation and Technology) to support innovation in CPI.[1]

The government's recent consultation response indicates the desire to drive the UK's position in CPI in order to harness the growth in interconnected and interoperable systems.

> "These interconnected systems, and the architectures, tools, platforms and data that underpin them, would underpin faster and cheaper innovation by providing the building blocks for innovators to design, test, build and connect their solutions more easily."[2]
>
> *Department for Science, Innovation and Technology Cyber-Physical Infrastructure Consultation Response, 2023*

It is clear that the UK vision for CPI is founded in the central idea of technological convergence, and the cross-sector opportunities and challenges this convergence enables.

# Cyber-physical infrastructure, the metaverse, and Web3

Changing terminology is not an indicator of progress

During 2021 and 2022, there was a noticeable shift in the language being used in technology innovation. Many of the companies Digital Catapult engaged with started describing their businesses and ideas in new terms. Immersive experiences, visualisation, gaming, fashion, and virtual goods have evolved into ambitions to build the metaverse, even though there has been no sudden change in the technologies being used, or their rate of adoption. The emergence of the term *metaverse* seems to imply a step-change in these advanced digital technologies, and the services they enable.

In reality, significant change to how people access and use online services will not come simply through increased adoption of virtual reality headsets or augmented reality glasses.

It is our view that real change will emerge when, and if, immersive applications converge with deep technologies, including blockchain and distributed ledger technologies (DLT), that hold the potential to disrupt existing centralised platforms and their business models.

CPI can be seen as an umbrella of technologies and use cases that are associated with industrial instances of the metaverse. Cyber-physical infrastructures that bridge the physical and digital will influence the future of work, leveraging Web3 and metaverse technologies, such as blockchain and immersive human-computer interaction paradigms.
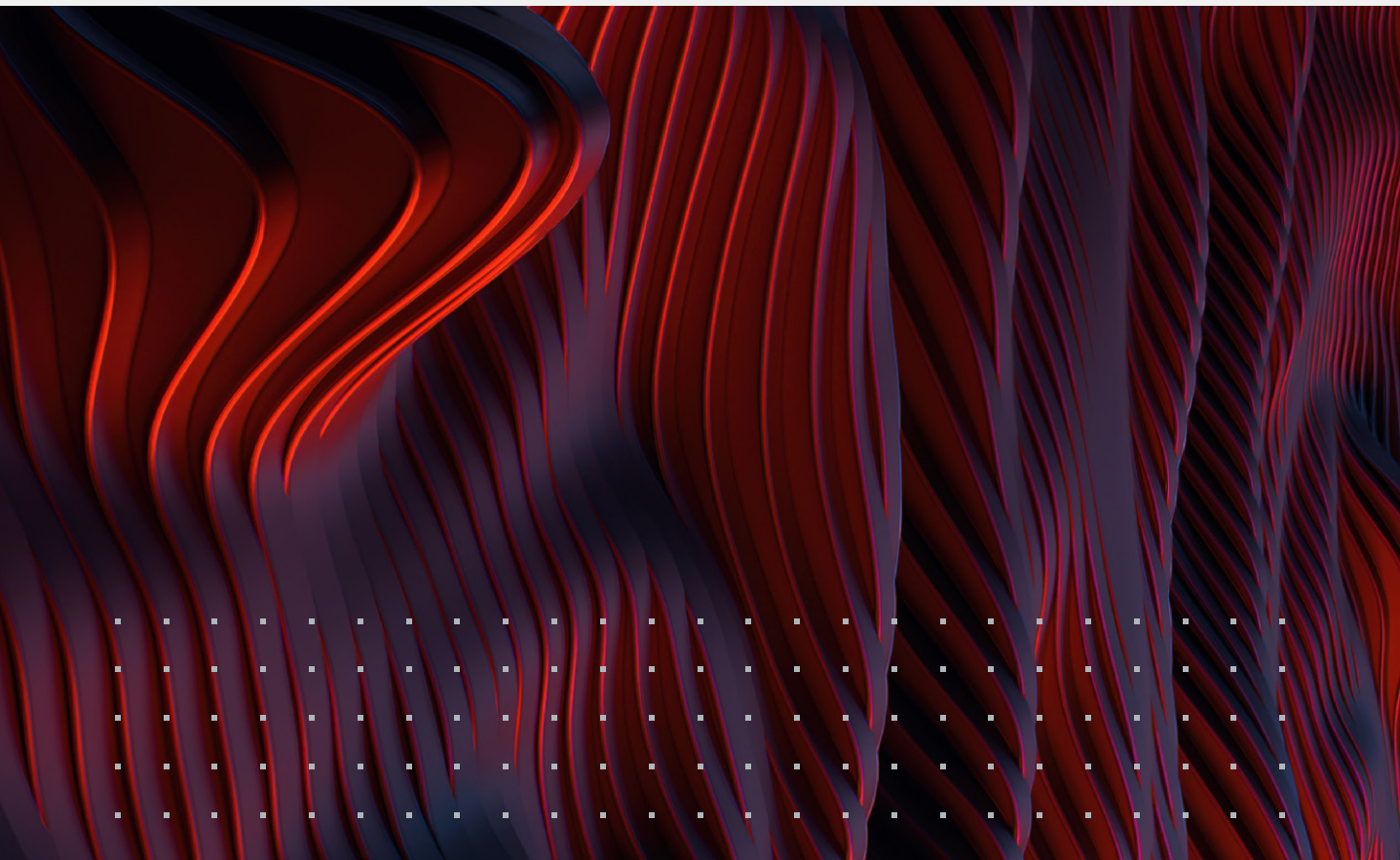
Why Web3?

We use Web3 to avoid potential confusion with the semantic web
(Tim Berners-Lee's description of machine-processable data on the web),
which has also been described as Web 3.0.[3] In the broader public eye,
Web 3.0 has also become associated with cryptocurrency and the
associated negativity that crypto has attracted.

In this report, Web3 refers to a constellation of cryptographic technologies,
including blockchain, smart contracts, and tokens in all their forms.
These all have the potential to change how ownership, transactions,
online communities and businesses operate in the future.

Cyber-physical infrastructure, the metaverse, and Web3

We might consider the metaverse as a cyber-physical system, bringing together immersive technologies and (potentially) 5G, AI, IoT and DLT to unite physical and digital environments through more embodied interactions. Web3 provides the underpinning infrastructure that enables transactions to take place on metaverse interfaces and applications, according to a set of models and principles. As these two systems converge in new and exciting ways, we can also categorise the combined use of the metaverse and Web3 under the CPI banner.

The UK's Robotics Growth Partnership (an independent advisory body established by government in 2019), indicates that CPI's proponents define its roots as being in computer science and engineering, rather than in creative industries and public services; in digital twins and smart enterprise systems, rather than in new creator economies and consumer goods and services.[4] This is notable, as metaverse discussions of the early 2020s have focused mainly on consumer-facing immersive experiences, NFT art and generative AI. The connections between the B2B-focused cyber-physical infrastructures, Web3 and the more consumer-focused metaverse have not yet been widely discussed.

Culturally, CPI, the metaverse, and Web3 may become closer to each other than technologists think. If we spend increasing hours of our professional lives interacting with smart digital systems, those cyber-physical systems will be underpinned by technologies not far removed from the metaverse and Web3 solutions that power the ways in which we spend our leisure time.
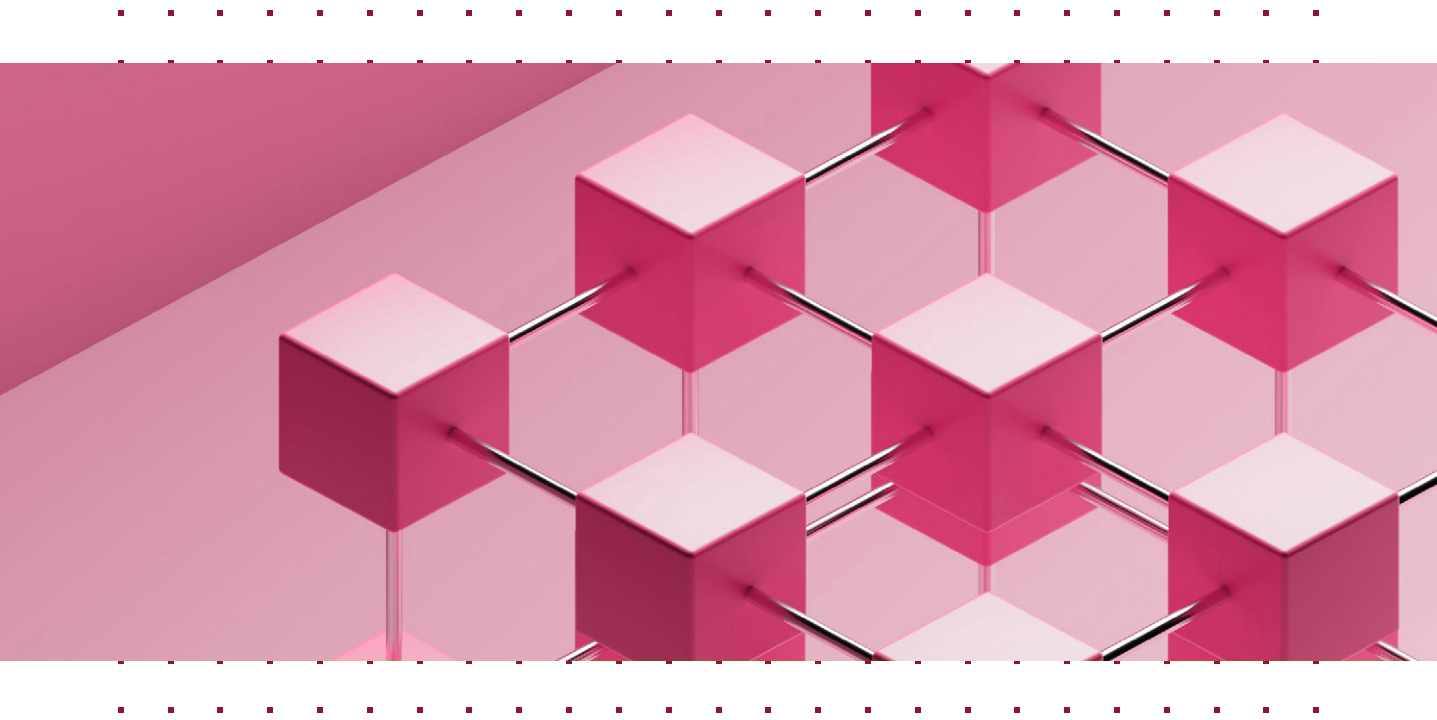
Leading immersive companies, such as Niantic Labs, have already been promoting the idea of a 'real-world metaverse'[5] where physical and digital converge through augmented reality applications. Furthermore, researchers who are proposing architectures that support metaverse applications are doing so via digital twins and smart cities, which are close to the CPI vision.[6]

This paper supports the B2B vision for CPI by focusing on companies that build software, content, content production tools or content distribution platforms, instead of hardware (such as robotics) or infrastructure (such as networks).

Our research

Goals and questions

The convergence of CPI with metaverse and Web3 technologies promises new business models, but like any nascent field with social, political, economical and environmental consequences, it also presents concerns and risks. We recognise both the enthusiasm and scepticism that surrounds technologies that claim to change paradigms, and in this report, we acknowledge the growing pains while trying to see beyond them.

We have evaluated **the state of the UK industry in the areas of convergence**, in terms of the products and services that are being built in the Web3 space and how they relate to what is going on in the immersive sector (now increasingly referred to as the metaverse sector). This sheds light on the most pertinent indicators for the next generation of digital services and goods, and the challenges and opportunities in building them.

We also set out to study **how companies in the UK are exploring convergence opportunities and perceiving the risks involved**. Current discussions around the metaverse and Web3 imply that towards the end of the 2020s there will be a step-change in how people create and consume digital content and services for leisure, personal life and work. This raises questions around the extent to which this shift is happening: who is building what to navigate the changes; and how those left behind will react.
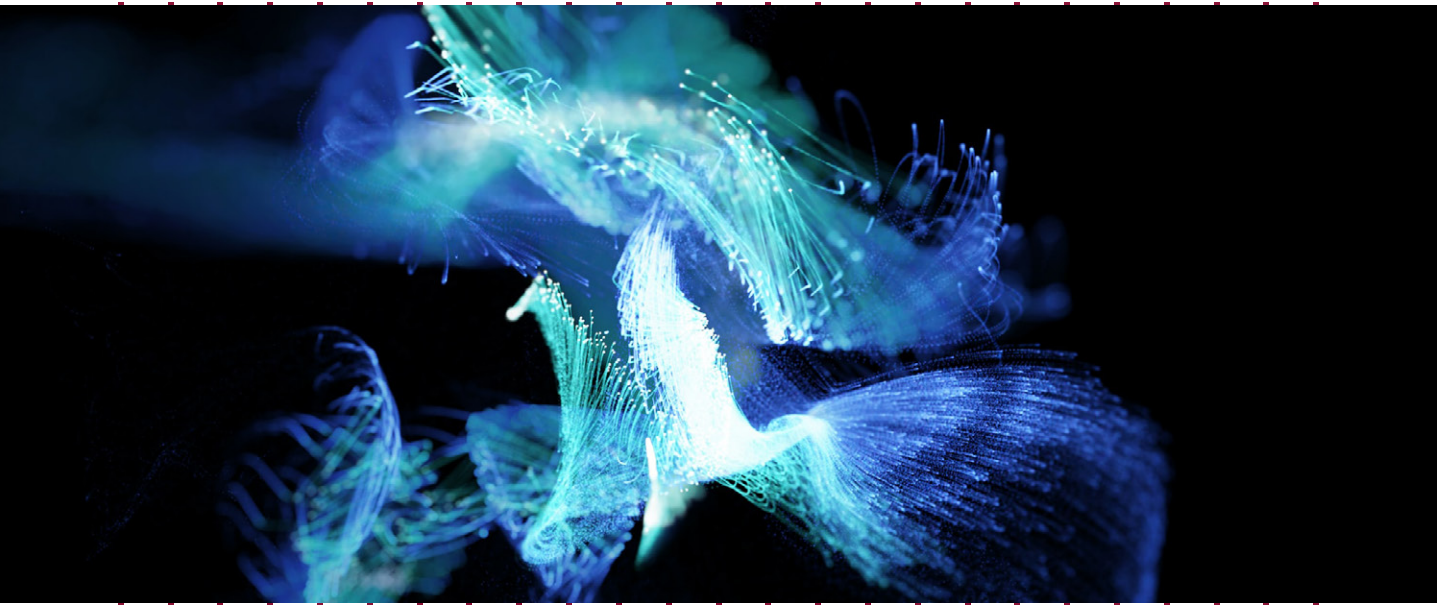
We wanted to find out **how UK-based technology companies are seeing and investing in metaverse and Web3 development**, so that we could present a neutral assessment of the opportunities and challenges that UK companies are encountering. We also wanted to map the current state of play of Web3 and metaverse convergence.

We translated these goals into the following research questions:

- What challenges do UK companies encounter when engaging with Web3 and metaverse opportunities?

- What are the emerging use cases for the metaverse in consumer and enterprise markets?

- What are the benefits of Web3-enabled decentralisation for different verticals, for example, for content creators?

Figure 1 visualises our line of inquiry going into the research: where are UK companies positioned in their approach to Web3 and the metaverse?
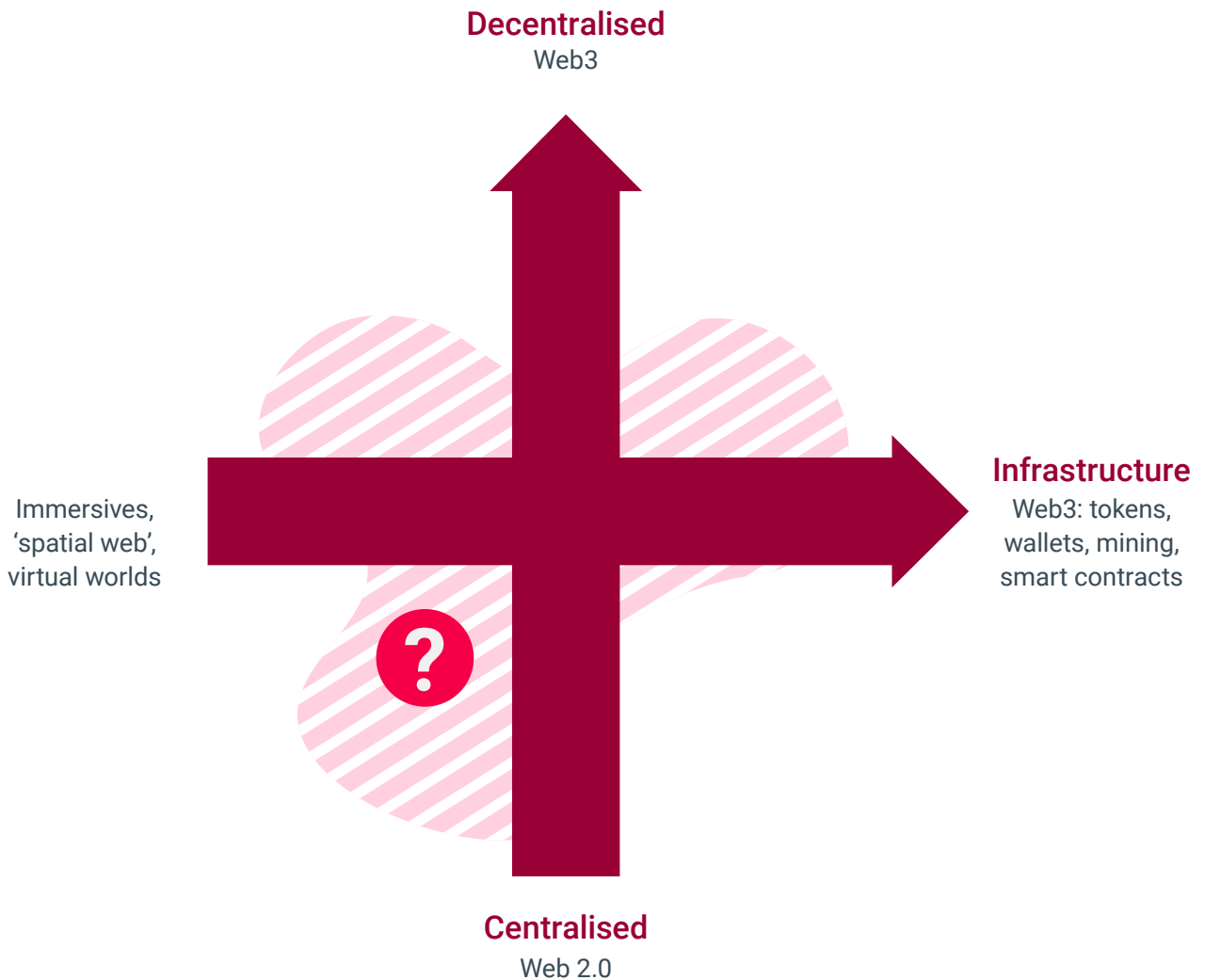

Figure 1.
The distribution of UK companies' approach to Web3 and the metaverse

The vertical axis illustrates the shift from centralised solutions — the 'walled gardens' of current platform holders — to more decentralised models that the proponents of Web3 have put forward.

The horizontal axis represents the range of approaches to infrastructure and content. For example, in the immersive market, companies tend to specialise either in user-facing content and applications, or on related production tools. Whereas in Web3, the spectrum runs from dApps (decentralised applications) to infrastructure solutions that enable transactions or distribution of assets. This would mean enabling networks, databases, data centres and their decentralised counterparts - as well as current 'flat' means of accessing information - with the more embodied and spatial interfaces that metaverse technologies promise.

The dotted area of the image maps our initial hypothesis that UK companies working in Web3 and the metaverse tend to have a more centralised approach, and are working predominantly on content and applications. We used this as our starting point, and our research findings have since enabled us to redraw this assumption - something we cover later in this report.

——————

Do UK companies believe this potential is too significant an opportunity to ignore?

——————

Past efforts in decentralisation have not lived up to their promise, and we expect there will always be a dynamic between centralised and decentralised models.

"

Proponents of Web3 believe that by decentralising architecture using the peer-to-peer model, a political decentralisation of power and control can be achieved. However, the physical and geographical decentralisation of architecture alone may not cause decentralisation of power and control."[7]

Digital Regulation Cooperation Forum, Insight Paper on Web3, 2022

Methodology

Our findings came from two separate research activities:

1. Mapping UK companies working in the metaverse and Web3 space

2. Conducting workshops to surface participants' sentiments towards the phenomena that fall under the umbrellas of metaverse and Web3

To ensure that insights were gathered from across the UK (and not biassed towards London and the South West), we reached out to approximately 80 companies, and representatives from more than 40 of them took part in our workshops held in Belfast, Bristol, London, Manchester, and North East Tees Valley.

We engaged with companies working in the metaverse or immersive space, and those working on Web3, regardless of their vertical. Our sample of companies was skewed towards the creative industries and the metaverse sector, but we also had participants from fields as diverse as construction and education.

We elicited workshop discussion through a creative exercise designed to inspire thinking around the various principles relating to the metaverse and Web3, and how such principles might be relevant to the participating companies' products and business models. We developed the exercise with a dual purpose: to gauge perspectives on the metaverse and Web3, and for businesses to use themselves to evaluate these technologies and their fit-for-purpose goals and strategies.

Our research period coincided with a significant Web3 market backlash, fuelled by the collapse of the FTX cryptocurrency exchange[8] in late 2022, which led to a serious shortage of investment in the market. It is difficult to quantify the extent to which this timing is reflected in our findings, particularly as participating companies were largely demonstrating cautiousness towards prioritising Web3 initiatives or not even paying attention to the technologies.

This report establishes the key concepts we used to articulate the background and purpose for our research, including decentralisation, what we mean by Web3 and metaverse, and how their convergence is manifesting in the early 2020s. This articulation was used in workshops when eliciting participants' views on the metaverse, Web3, and the broader topic of convergence. The report then documents the findings from our workshops, and identifies the challenges — technological and legal — that might prevent UK companies from pursuing innovation activity, particularly in Web3.

Web3 and the metaverse

- Principles and promises

- Web3: the next evolutionary era of the internet

- Centralisation vs decentralisation

- The metaverse: making sense of the hype

- Metaverse definitions and principles

- Web3 principles, and what they enable

- The current state of interoperability

Web3 and the metaverse

———

This chapter establishes our position on the main characteristics of Web3 and metaverse technologies, as they applied to our research activities.

———

Web3: the future of the internet

Seen as the next evolutionary era of the internet, Web3 builds out from the paradigms of Web 1.0 and Web 2.0 that came before it.

Web 1.0

Web 1.0 (approximately 1991- 2004) was largely made up of static web pages that could only be read. There was no requirement for users to log in, and no ability to interact with posts or view analytics. Most of the early internet was not profitable, even through advertising, and it could be likened to a large, hyperlinked Wikipedia. Improvements that enabled interactivity, and audiovisual elements such as Flash and Javascript were introduced, but internet users during this time were primarily consumers of information.

Web 2.0

We are currently in the Web 2.0 era, which began around 2004. Web 2.0 was heralded by new developments in interactivity across multiple platforms and devices, from computers to mobile devices. Owners of existing platforms could now collect information from users visiting their sites.

As well as providing site owners with valuable insights into user behaviours and preferences, centralised companies (including Meta, Google and Microsoft) have been able to monetise user data and sell it to advertisers.This has resulted in Web 2.0 becoming somewhat defined by targeted advertising, shifts to mobile access, and a lack of privacy for users, who have (largely unknowingly) sacrificed privacy for the convenience of engaging with pages of interest and social media platforms.

Web3

Web3 is expected to offer the potential for users to own and control how their data (and data about them) is shared and accessed, removing ownership from third parties.
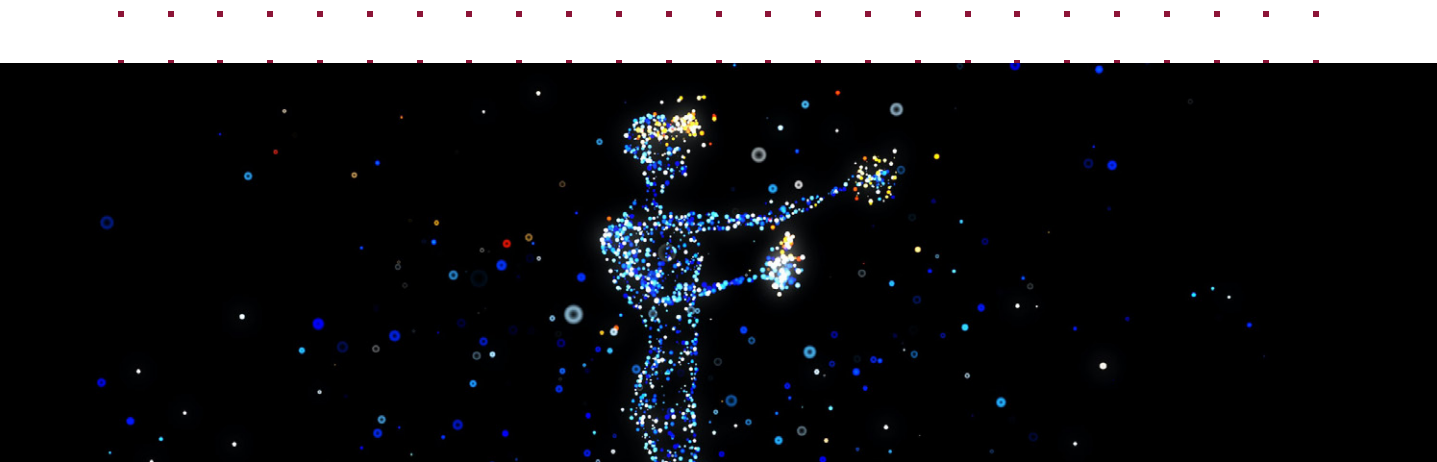
- Web3 has been referred to as the web of decentralised applications, and aims to bring greater security and privacy to online interactions and transactions primarily through the use of blockchain systems and smart contracts.

- One of the most significant aspects of Web3 is the potential for users to own a digital identity that is not completely connected to their real-world identity. This means that online activities, such as viewing pages, downloading content and making purchases, can be performed without being traceable to an individual's true identity. Self-sovereign identity (SSI) allows individuals to authenticate themselves with services legitimately while reducing personal data exposure to a minimum. Web3 wallets, which are largely associated with storing the private keys to cryptocurrency, are expanding into tools that users can use to verify their pseudonymous identity across Web3 services.

- There are already ways to achieve anonymity online (VPN is a commonly-used example), and the increased decentralisation of Web3 may enhance the availability of such services. There is also evidence that personal data stored in public and permissionless blockchains can produce the opposite effect: a highly detailed record of a user which contains information that cannot be changed.[9]

The full impact and potential of Web3 are still unknown, but it is expected to bring significant changes to the way the internet functions. Odysee is an example of a Web3 platform offering an alternative model to existing popular applications. It is a blockchain-based alternative to YouTube where users can post and share videos stored on a decentralised network rather than on a central server, making it more secure and not governed by a single entity.

"

The first versions of Web3... have had severe drawbacks, such as wasting energy, enabling crime, and exhibiting huge volatility. However, the more recent versions of these same technologies have the potential to transform the internet from a loosely structured communications medium to a reliable but distributed transaction medium.

A reliable distributed transaction platform could provide agency for communities, enabling neighbourhoods and local organisations to regain control of their resources and allowing them to chart their own future."[10]

Professor Alex Pentland, MIT

Phenomena and promises

The metaverse

Instead of pursuing a comprehensive definition of the metaverse, we approach it as a collection of phenomena enabled by a range of advanced digital technologies. Broadly speaking, the metaverse is an idea about how a next-generation internet would work. The idea implies that metaverse as the future of the internet offers services and means of communication which are accessed via immersive or spatial human-computer interaction. Examples of metaverse use cases include immersive community platforms, experiential retail, immersive education, virtual and 'phygital' goods, multiplayer location-based games, and online collaboration and content creation tools.

To avoid conflating the metaverse with the broader arena of XR, we do not take the position that the emergence of the metaverse is related to the current adoption rates of virtual or augmented reality.[11] Although some of its services might benefit from the interfaces and immersive nature of VR or AR (as the most compelling or productive way to access them), the metaverse does not necessitate technologies such as VR and AR. Our approach champions interoperability, and technologies such as WebXR that are better positioned to facilitate accessibility and inclusivity, and that still demonstrate immersive technologies' unique qualities for designing human-computer interaction and embodied experiences.

Web3

We see Web3 as an emergent set of phenomena and technologies that includes:

- Tokenised ownership of assets and access to content

- Verifiable and trustless transactions

- Decentralised organisations, distribution models and communication protocols

- Self-sovereign identity

- Distributed computing

Figure 2 visualises the concept of the metaverse built on a set of user-centric principles, and how various experiences related to work, civic life and leisure are virtualised. The Web3 technology stack provides the underlying infrastructure — the 'plumbing' — and this is where transactions initiated in the metaverse are recorded.

METAVERSE

Networked
and data-driven

Content, asset
and service-driven

Immersive
and social

User-centred
and empowering

GENERAL　　SPECIFIC　　CONVERGENCE　　SPECIFIC　　GENERAL

Decentralised
and secure

Trustless

Public and
permissionless

Creating value
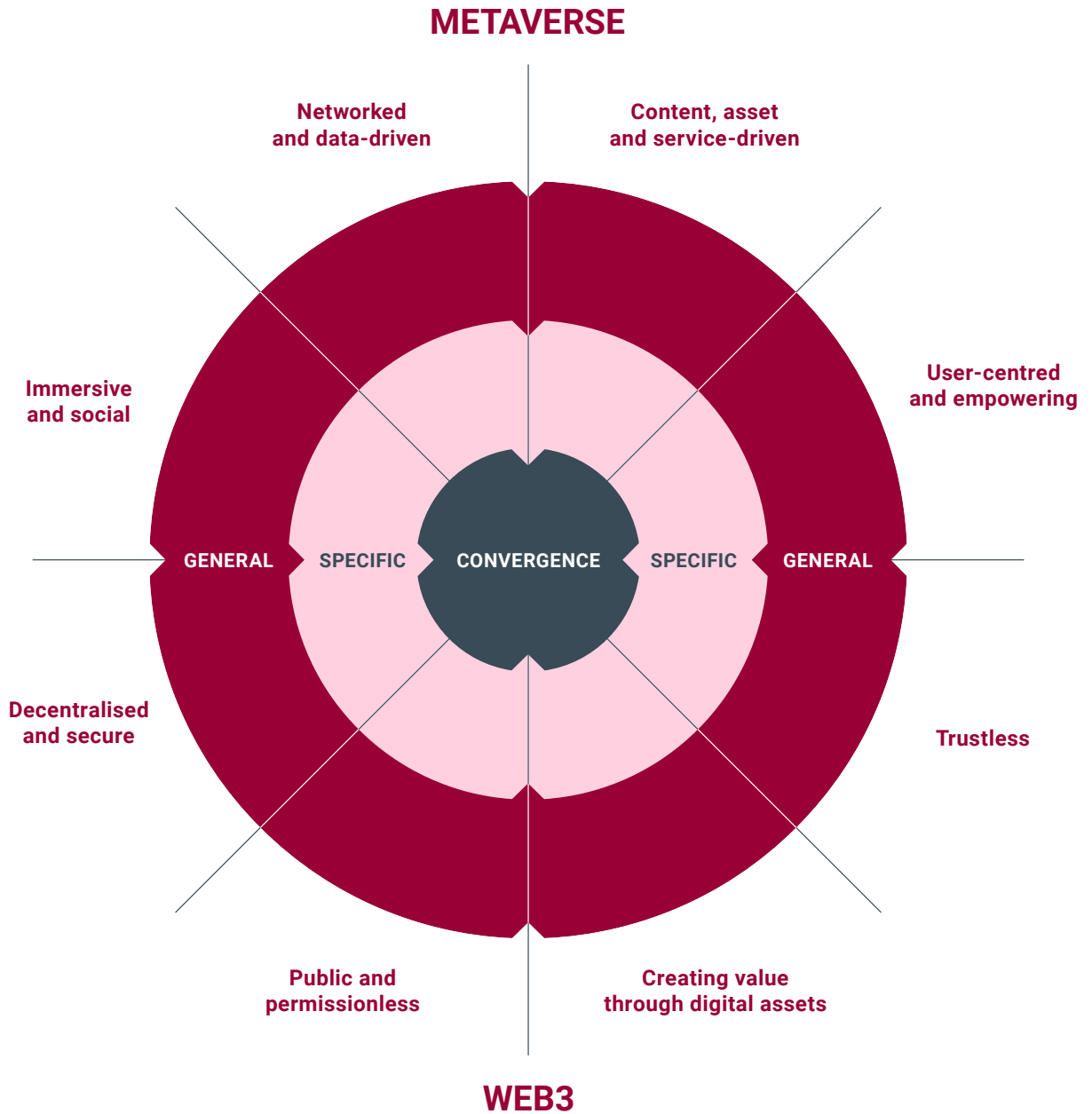through digital assets

WEB3

Figure 2.
Metaverse and Web3
convergence and principles

The underpinning infrastructure of Web3 consists of various layers. Blockchains provide the settlement layer: the foundation for transacting digital assets (such as cryptocurrencies and other tokens), enabling information exchange protocols, and running smart contracts, decentralised applications (dApps) and services that function as user interfaces with the technology stack.[12]

- Examples of dApps include file storage services (Storj), token swap services (Uniswap.org), freelance recruitment platforms (Atlas.work), and many more

- Social networking apps Phaver and Orb are also working to disrupt the paradigms currently embedded in popular social media platforms by building on the Lens Protocol: a decentralised social graph that uses blockchains to enable users to take their audience from one Web3 platform to another

- Such dApps operate on blockchain consensus mechanisms to achieve agreement, security, and trust across decentralised computer networks (most famously, the proof-of-work and proof-of-stake methods), ownership of user data and its portability across similar decentralised platforms

Blockchain

A blockchain is a **database or digital ledger of transactions that is duplicated and distributed across an entire network** of computer systems, and is a highly decentralised technology that dates back to the late 2000s. Some blockchains are capable of executing autonomous computer programs (smart contracts) that run automatically when certain conditions are met — for example, when transacting between parties using tokens. **This system of recording makes it difficult or impossible to change, hack, or cheat the system.**

Centralisation vs decentralisation

It is our view that the tension between centralisation and decentralisation is a key focal point for effectively examining developments around the metaverse and Web3, in order to understand where their convergence might lead.

For centuries, the traditional way of managing the world's information has been through a handful of centralised entities: from national libraries and publishing houses to media trusts and the large corporations amassing today's digital data. The original vision for the internet in the 1960s was information decentralisation, and a number of networks were developed to allow computers to talk to each other. When the United States Department of Defense started the Advanced Research Projects Agency Network (ARPANET), the main aim was to make the internet resilient to physical attacks, so that even if an entity disconnected or destroyed a large number of computers, the network as a whole was not affected.

This decentralised structure also made it extremely difficult, or so it seemed, for any one person, organisation or government to control the flow of information or censor any piece of information added into the system by one or multiple users.

> "Under various labels, such as 'Web 3.0',
> 're-decentralisation', or 'blockchains', various
> communities have been trying to implement
> techno-social systems where technical
> decentralisation is consciously used to pursue
> social, economic, or political goals.
>
> In practice, however, such projects often involve and
> depend on centralised infrastructures or decision-
> making, or indeed produce centralising effects."[13]
>
> *Decentralisation: a multidisciplinary perspective B Bodó,
> J K Brekke, J. K. and J H Hoepman (2021)*

However, as the internet grew in popularity, it started to become increasingly centralised, partly due to the rise of the large tech companies that now dominate the online landscape. These companies, like Google, Meta (formerly Facebook), Twitter and Amazon, are the owners of large networks of servers and data centres that have vast capacity, and have been growing their ownership of the internet over the course of the last couple of decades. These entities have essentially formed the current iteration of the internet, Web 2.0.

Web3 is expected to bring significant changes to the internet in the coming years, including increased decentralisation and the potential for enhanced privacy and security for users. While its exact impact and potential is still uncertain, this is likely to be a gradual evolution of ideas rather than the result of a single, sudden revolutionary change. It is possible that decentralisation (especially if driven by regulation) will enable a competitive landscape that may eventually lead to the dismantling of global centralised tech giants, to be replaced by decentralised autonomous organisations (DAOs), though the timeline for this potential vision remains unclear.

If a specific set of external human factors forced the emergence of decentralised Web 1.0 then arguably, there is a high probability that the same set of factors will propel the move from Web 2.0 towards the increased adoption of Web3. There is a high likelihood that the number of new adopters will grow linearly at first, and then exponentially if Web3 components, such as wallets and tokens, are accepted into the mainstream.

This back-and-forth between decentralisation and centralisation can be likened to a pendulum changing direction in a swing that could range from five years to a couple of decades. After Web3, the world will likely change to a new system again, predominantly characterised by the use of a centralised internet — perhaps the new Web4 — which makes the metaverse truly interoperable, accessible, and part of everyday global life.

Metaverse

The word *metaverse* dates back to Snow Crash (1992), the novel by science fiction author, futurist and now Web3 entrepreneur of Lamina1, Neal Stephenson. Its adoption is similar to the proliferation of the term cyberspace, originated by another science fiction author, William Gibson, which emerged into the broader consciousness in the early 1990s.

The metaverse:
making sense of the hype

We use the term *metaverse* to refer to services and platforms that leverage a host of advanced digital technologies for the next generation of the internet. *Meta* comes from Greek, meaning 'after, behind; among, between'; *verse* is derived from universe, implying totality. So *metaverse* fundamentally implies the ability to bring multiple universes together - in this case, to bring various online services and assets to work in an interoperable way to serve business and user needs.

Investor and author Matthew Ball has become one of the foremost thinkers in the worldwide metaverse discussion. He highlights how the evolutionary path of technologies such as electricity and the mobile internet profoundly changed human cultures, but that their proliferation depended on a number of interconnected innovations to accumulate that would enable them to scale. When these technologies started to emerge, even the highest level of expertise did not enable contemporaries to predict how everything would coalesce, and the world would change as a result.

Microsoft veteran Steve Sinofsky recently wrote a reminiscent account about how the information superhighway emerged in the 1990s as an idea that attempted to articulate how "a wide variety of consumer services would be available directly to home computers using a new type of data connectivity offered by phone or cable companies".[14]

Today, as we have travelled almost through and beyond notions of the information superhighway, the metaverse now looms on the horizon.

> "The metaverse is an expansive network of persistent, real-time rendered 3D worlds and simulations that support continuity of identity, objects, data, and entitlements, and can be experienced synchronously by an effectively unlimited number of users, each with an individual sense of presence."[15]
>
> *Matthew Ball, Framework for the Metaverse, 2020*

The 2D, asynchronous paradigms of the information superhighway are very different to those of the synchronous 3D metaverse, where isolated instances of use on individual platforms transmute to embrace continuity of data and ownership across all platforms. In practice, this would mean that someone could take their 'social graph' of followers from one social media platform seamlessly to another, use the same avatar as their expression of identity across various platforms, and provide educational certificates and career achievements provide impeccably validated (recorded and stored transparently in a blockchain) that can be acknowledged across institutions globally.

Metaverse: an overheated buzzword?

One interpretation of how hype has arisen around the term *metaverse* is based on the huge popularity of gaming services such as Fortnite and Roblox. These services have started to expand from their original gaming-only focus to host broader pop culture events for millions of concurrent users, a development which has made the possibility of an interoperable, all-encompassing metaverse seem within reach.[16]

Yet, even in 2023, no startup building a state-of-the-art cross-platform avatar service, industry expert on file format compatibility, or CEO of a popular social network is able to rely on their sole leverage to launch the metaverse to the entire world. They might be able to launch a galaxy into their particular universe that represents the variety of similar services being built, but the individual galaxies seldom communicate with each other.

Any notion of the metaverse as an open universe of individual galaxies necessitates both the underlying enabling technologies (networks, data centres, blockchain layers, payment methods) and the interfaces that we access them through. These interfaces – the layer of the metaverse that is the most visible to end users – are typically described as 3D, spatial, or immersive, implying that the next-generation internet will take users from looking at a flat screen to navigating a virtual space in a more embodied way.

However, the history of technologies that are often associated with the metaverse, such as AR and VR, shows that it has taken approximately 40 years for them to reach consumers at affordable price points. While the rate of technological advance is accelerating, the current variety and incompatibility of building blocks for the metaverse means that current discussions can be inflated with too much optimism, too many promises, and positive predictions that are meant to attract investors. Yet, there are companies that have been quietly building the plumbing for the metaverse for years, and others that are innovating in how we interact with digital worlds and assets.

Definitions and principles

Metaverse definitions

Definitions of the metaverse by large consultancies serve their need to sell metaverse-related services and offerings. Deloitte talks about the metaverse as a future world where the virtual and the real have converged, with four different meanings or aspects.

> "...a virtual mirror world that simulates the real world, an innovative virtual world set apart from the real world, the real world as a facet of the metaverse, and the convergence of the virtual and real worlds beyond either the virtual or the real world."[17]
>
> *Deloitte, The Metaverse Overview: Vision, Technology, and Tactics, 2022*

Deloitte's four aspects of the metaverse exist, albeit in simple form, when compared to the vision of the metaverse as a 3D, next-generation internet:

- Online map services

- Various virtual worlds and multiplayer games

- Persistent augmented reality content in the real world

- Location-based mobile games or apps that assign specific meaning to real world locations and draw contextual information from them as part of the user experience

In contrast, organisations that work towards metaverse standards will produce different definitions, because their knowledge and motives are different. A community wanting to develop standards will work with abstractions that are practical for developing components (such as environment, profiles and objects) that need to work together to enable interoperability. This will shape their definition of the metaverse.

> "A metaverse instance is a collection of Digital Environments that are implementations of Common metaverse Specification Profiles; it is populated by Digital Objects that are representations of either real Objects — called Digitised — or computer-generated Objects — called Virtual — or both."[18]
>
> *The Moving Picture, Audio, and Data Coding by Artificial Intelligence (MPAI), 2023*

Metaverse principles

This report draws strongly from Matthew Ball's definition of the metaverse, while extracting similar qualities and keywords from various other definitions. Taking into account the range of perspectives across the spectrum of industry reports, academic writing, government areas of alignment and popular narratives, we distilled our findings into four central principles.

Immersive and social

The metaverse promises to enable the next generation with the means to access the internet in embodied ways where physical and virtual worlds converge. This implies three-dimensional online environments where users can create, consume content and spend time with each other.

Highly networked, computation-heavy and data-driven

The metaverse will require persistent high bandwidth and low latency connectivity to create an authentic sense of presence and seamless quality of experience. It requires an infrastructure that supports vast amounts of data traffic, storage and computation to be able to render high-definition environments and leverage AI-powered services.

Content, assets, and services-driven

The metaverse supports economic activity in multiple forms, ranging from the sale and distribution of digital assets (such as virtual goods and currencies) to services that facilitate transactions.

User-centred and empowering

By converging with underlying Web3 technologies, the metaverse promises to empower users by returning their control over data tied to their identity (an evolution from the closed Web 2.0 principles). It promises changes in how users spend their time and attention, how they participate in civil and community matters, and how experiences and assets can be shared. We used these four principles to provoke discussion and inspire thinking during the workshops and roundtable discussions through which we collected data about the UK ecosystem.

Web3 principles, and what they enable

In our document delivered to the Treasury in 2022 — Digital Catapult, Accelerating Opportunities for Web 3.0 Overview, Trends and UK Opportunities — we defined six core principles for Web3.

Data sovereignty

Individuals should have control over their own data, managing their own personal data, without relying on centralised platforms or entities. This has the potential to bring about a new paradigm where users can interact with other users or services while giving away virtually no personal information if they choose — in marked contrast with what's happening today.

Decentralised

This principle determined an internet predominantly governed by decentralised systems used to record information, where interested parties have the ability to transfer data between themselves in a peer-to-peer manner without the need for intermediaries, such as large corporations or banks.

This would mean that virtually every vital system that we use on a daily basis becomes trustless (absent of third parties) and permissionless (interacting without third party permissions). Blockchain tends to have these attributes, which explains why it is often seen as synonymous with decentralisation.

Secure and encrypted

Security is constantly improving. Therefore, *secure* in this context does not mean a marginal improvement in cybersecurity, but rather a massive leap forward in anything security-related. Web3 offers new ways to keep digital assets secure (for example, using hardware wallets), or ways to upgrade smart contracts to make them more robust (like those designed with formal verification). *Encrypted* refers to new types of systems built primarily using complex cryptographic primitives, such as asymmetric cryptography, threshold cryptographic signatures, and zero knowledge cryptography.

Open

Platforms would be built in such a way so that anyone can contribute to them. Developers who are striving for decentralised systems tend to prefer projects that are open-sourced. Openness as a criterion for adoption seems to favour other Web3 phenomena, such as decentralised autonomous organisations (DAOs) that represent new ways for businesses or communities to self-organise.

Transparent

This principle supports the idea of systems that only support certain types of actions in a transparent manner, for example, developing the NFT market so that all sales are transparent.

If a malicious user tries to pass off a stolen or fake NFT as genuine, the public will be able to see and warn prospective buyers. With transparency comes fairness and, in this respect, many decentralised exchanges are considered to be fair when compared to those that are centralised.

Distributed

Distributed computing is a nebulous concept, generally referring to the building of new platforms using elements such as multi-party computation, federated learning, shared computing power or storage incentivised by micro-payments. If more Web3 initiatives take this direction, we are likely to see new systems crunching data for the benefit of decentralised organisations, as well as large centralised ones.

Overall, these Web3 principles aim to create a secure and encryption-rich, decentralised, open, transparent, distributed and efficient internet that helps users become sovereign. However, as the Digital Regulation Cooperation Forum has identified, there are still unresolved questions that need to be addressed, relating to areas such as regulation, automation and immutability.[19]

For the purposes of the convergence model that we used in this research, we condensed these six principles into four:

- Decentralised and secure

- Public and permissionless

- Creating value through digital assets

- Trustless

We combined the principles of decentralisation with security, distilled the principles of openness to public and permissionless, and opened the way to invite more concrete thoughts about tokens with the sector about creating value through digital assets that embodies several qualities from the other Web3 sectors, such as ownership and transparency.

The current state of interoperability

The principles that the metaverse and Web3 technologies operate on might become part of our everyday lives by the end of this decade. However, for that to happen, these principles need to prove their value across a wide spectrum of use cases. Technologists and businesses building the metaverse and Web3 need to strive for high interoperability, otherwise the improvements that Web3 promises will be incremental at best.

Interoperability refers to how computer systems or software are able to exchange information and use it across different systems. For example, image file formats such as JPEG are based on standards that manufacturers of various devices support, and therefore we can send digital photographs from Apple iPhones to Android phones. But, we cannot run a file that is used for distributing mobile apps on Android (an .apk) on an iPhone. Interoperability is about the continuity of data, assets, and their authentication across digital services.

In order to become the cornerstone for the next iteration of the internet, Web3 principles need to have a high degree of interoperability and standardisation. The same applies to the ways in which we can use it if we are to immerse ourselves and spend time in the metaverse, whether for work or leisure. The convergence of these technologies can then become something that captures people's attention and creates significant value.

The metaverse and interoperability

With the promise of the metaverse as the next generation immersive internet, the interoperability issue extends to more complex information. The strategic advisory business, Global Counsel, has stated that developing a clear position on interoperability is **"the most urgent policy debate around the metaverse"**.[20]

It will become increasingly common for individuals to employ 3D avatars as representations of their identity in the metaverse. Those avatars will also include information related to animations, textures, direction of gaze, and even simulated physics, which makes their interoperability across systems - such as two different virtual worlds - more difficult to execute. From a developer's perspective, interoperability comes down to file format standards and how the same formats are supported across different platforms. Multiple standards groups such as the World Wide Web Consortium and the new Open Metaverse Alliance for Web3 (OMA3), have begun to address these challenges.[21] The ability of file format initiatives such as USD (Universal Scene Description) and glTF (GL Transmission Format) to evolve and gain traction will be critical for interoperability to become real.

The World Economic Forum and Accenture have divided the question of metaverse interoperability into three aspects: technical, usage and jurisdictional interoperability.[22] They associate technical interoperability with the hardware and software level issues, while usage interoperability is about inclusive access, regardless of global or demographic differences. Jurisdictional interoperability would mean that there are legal standards (related to accountability, identities, and transactions) that apply across global markets and national and local borders.

Interoperability is a multifaceted aspect of information exchange, and therefore its practical implementations require careful ethical consideration. Advances in far-reaching metaverse interoperability might come at the expense of safety and privacy, similar to current concerns about the all-encompassing decentralisation that the Web3 technology stack promotes.

Consideration for technical, usage and jurisdictional interoperability also applies to Web3 as a whole. Blockchain technology, in particular, promises transparent and secure methods of exchanging information, which is an example of how the Web3 infrastructure can help in advancing interoperability in the metaverse layer where the exchanges of information are initiated. Otherwise, the scope of interoperability might remain in highly specialised (yet popular) components of the metaverse, such as avatars.

Web3 interoperability

The interoperability of Web3 platforms is more mature than within metaverse platforms. More and more Web3 solutions are being built with interoperability in mind, and development methodologies are becoming more standardised. A set of universally adopted standards is likely to push this industry forward towards mass adoption.

The concept of uniform user experiences is critical for Web3, and we can see mass adoption starting to take place with the Ethereum Virtual Machine (EVM). EVM software executes smart contracts and computes the state of the Ethereum network after each new block is added to the [block]chain.[23] It appears that most blockchains, sidechains (separate blockchain network that connects to another blockchain) or further layers are becoming EVM-compatible. More and more people are building digital assets using EVM-compatible blockchains. EVM looks to standardise development in Web3 in the same way that HTML did for the World Wide Web in the 1990s.

Like Lens Protocol, mentioned earlier, there are an increasing number of projects focused on creating interoperability protocols and platforms to allow different blockchain networks and other distributed systems to communicate and interact with each other. Web3 builders are using techniques to jump seamlessly from one chain to another, or technologies like bridges that connect different blockchain systems. Creation of a more connected ecosystem will benefit users by, for example, allowing them to move certain assets onto a sidechain to reduce their gas fees (transaction fees), while still being able to interact with those assets.

At Layer 0

Layer 0 is the network layer that allows developers to launch their own blockchains, and here Polkadot is one of the most popular interoperability protocols in use. Polkadot is a heterogeneous multi-chain platform that enables the transfer of assets and data across different blockchain networks. The network uses a unique relay chain to connect different blockchains, enabling them to communicate and interact with each other seamlessly. Cosmos is another popular interoperability protocol, a decentralised network that enables the transfer of assets and data across different blockchains. It uses a hub-and-spoke model, connecting different blockchains to a central hub to enable cross-chain communication.

Building bridges

Several interoperability platforms have emerged for building bridges or other systems designed to connect various dispersed elements. These platforms provide a seamless way for different blockchain networks to communicate and interact with each other.

One of the most popular interoperability platforms is Chainlink. This is a decentralised oracle network (DON) that enables the transfer of data between different systems such as smart contracts or databases. The platform provides secure and reliable data feeds to different blockchain networks, enabling them to interact with each other seamlessly.

It is important to highlight that in Web3, users have a high degree of freedom when using their identity files and cryptographic keys. If a user is no longer happy using a particular wallet to store their digital assets or SSI identity, they can transfer their funds to a different wallet that will have its own unique seed phrase (collection of randomly generated words). Users have full wallet data portability, thanks to the implementation of Bitcoin Improvement Proposal number 39 (BIP39) for seed phrase design.[24]

One of the biggest challenges is the issue of trust. Different blockchain networks have different levels of trust, and transferring assets and data between different networks can be challenging. Ensuring the security and reliability of cross-chain transactions is crucial for the growth of Web3 interoperability.

In conclusion, Web3 interoperability is crucial for the growth of the blockchain ecosystem, enabling seamless cross-chain communication and data sharing. While Web3 interoperability is still in its early stages, several projects and initiatives are focused on addressing the challenge. Protocols and platforms are emerging to enable cross-chain communication and data sharing, creating a more connected and efficient blockchain ecosystem. However, several challenges still need to be addressed to enable seamless Web3 interoperability, including standardisation and trust. As the blockchain ecosystem continues to grow, Web3 interoperability will become increasingly important, enabling a more connected and efficient ecosystem.

Web3 and the metaverse: seeking convergence

- Web3-driven use cases for convergence

- Metaverse-driven use cases for convergence

- Business models emerging through convergence

- The metaverse-Web3 radar model

Web3 and the metaverse: seeking convergence

> "What the Long Nose tells us is that any technology that is going to have significant impact in the next 10 years is already at least 10 years old. Any technology that is going to have significant impact in the next 5 years is already at least 15 years old, and likely still below the radar. Hence, beware of anyone arguing for some "new" idea that is "going to" take off in the next 5 years, unless they can trace its history back for 15."
>
> *Bill Buxton, The Long Nose of Innovation, 2008*

Defining the current state of nascent technologies and their implementation is a moving target. However, it is possible to gather evidence about where technologies are going, both in terms of their technological evolution and how businesses are adopting them — with adoption being the most relevant to this report.

How useful are metaverse and Web3 technologies at solving problems for a diversity of businesses and end users, regardless of the resources at their disposal?

To explore the question of adoption by businesses, we briefly summarise examples of both Web3-driven and metaverse-driven projects. Rather than document an exhaustive list of use cases, we use current literature to present examples and their implications for business models. This summary of examples served as a backdrop and point of comparison for the input from UK companies during our data collection workshops (the outputs of which are described in the next section). This would help us to determine the extent to which use cases promoted by international consultancies and Web3 agencies are reflected in what is happening in the UK ecosystem.

When analysing the benefit of an emerging technology, it is always fair to ask whether it is a technology searching for a use case, or if it actually solves an existing challenge in a more efficient, sustainable, or user-friendly way.

Deloitte identifies five trajectories of user value in the metaverse, claiming that they span both the material and the spiritual.[25]

- Entering the metaverse with entertainment such as games

- Promoting real world efficiency, such as via education and shopping

- Living a 'second life' on creative collaboration platforms

- Gaining new influence and social status in virtual communities

- Generating new income via trade

Web3 consultancy Vayner3 sees convergence from a slightly different perspective, describing a consumer blockchain[26] where the metaverse is subsumed into Web3, and blockchains are the glue for a convergence that revolves around digital worlds, tokens, and consumer behaviour.

While it is difficult to define exactly the type of product or service that qualifies as a metaverse instance, looking for convergence (that is, products and services that demonstrate both metaverse and Web3 principles, as defined in the previous chapter) is an easier task — even if it might yield fewer results in absolute terms. This is because within the cluster of metaverse and Web3 technologies, we find that the most innovative developments are currently happening at points of convergence between one or more metaverse services and one or more Web3 technologies.

Web3-driven use cases for convergence

How are businesses, or other users, responding with products and services to the value-creation opportunities that Web3 principles promise? To give a flavour of how brands are experimenting in the convergence, in November 2022, Vayner3 defined several 'emerging product archetypes' that explore new business opportunities and models:

- Bundles: digital + physical + experiential

- Digital worlds and wearables

- Token-gated products and experiences

- Token-enabled focus groups

- Engagement, loyalty and rewards

Vayner3 has drawn the archetypes by surveying real-world projects, mainly from the area of luxury goods, such as clothing and sports brands ranging from Nike to Gucci, but also from retail goods, such as Starbucks.

According to Vayner3, the Web3 dimension is currently the driver in these efforts. Metaverse elements (tie-ins to virtual worlds, for example) require investment that should be evaluated from the point of view of a Web3 strategy, rather than the other way around.[27]

This indicates that in the short term, consumer applications in the convergence of metaverse and Web3 are skewed towards the mobile web, and so they are (at best) 'Web2.5' in their ambition and implementation. In other words, they are trying to shoehorn Web3 elements into the established Web2 ways that consumers engage with information.

An example of token-gated products and experiences would be a brand issuing a token that requires its customers to create a crypto wallet, after which the customers are able to get access to exclusive goods, digital or physical, using their wallet identity. Online retail platforms such as Shopify have started to support token-driven campaigns for their business customers, which is an indication that the threshold for smaller businesses to experiment with Web3 concepts is lower than before.[28]

Metaverse-driven use cases
for convergence

When the vector of convergence is predominantly from principles of the metaverse towards those of Web3, gaming platforms like Roblox and Fortnite tend to be cited. Yet they are both native to Web 2.0, and centralised in terms of how they store and process information and handle users' accounts and ownership of assets. For example, an avatar's virtual goods are "leased within the platform of purchase" (McKinsey & Company[29]), whereas in a Web3 native platform, the same assets would be owned by the user as non-fungible tokens in their wallets. In principle, pending robust interoperability, these assets would then be available to use on other platforms that support similar functions, such as embodying one's presence in the space as a personal avatar and customising it with virtual goods.

While such interoperability is not in place yet (although startups like Ready Player Me are attempting to build towards it), there are examples of metaverse platforms that leverage tokens for ownership. Decentraland is one of these virtual worlds where cryptocurrencies are the primary means of transaction. In an interesting example of convergence, cryptocurrency exchange service Transak (which is a purely Web3 company) has implemented a virtual ATM into the Decentraland world.[30]

From a user experience point of view, this is a highly tangible instance of convergence: the user is immersed in the 3D world, a metaverse instance, and can interact with an ATM there to exchange fiat currency into cryptocurrency that can be exchanged for goods within the Decentraland world. Decentraland is accessible through a web browser or desktop client and does not require or support VR headsets (yet).

In early 2023, Decentraland had reached close to 800,000 users, but the number of daily active users transacting using cryptocurrency there could only be counted in hundreds.[31]

While platforms like Decentraland are growing, they do not constitute mainstream adoption. In 2022, it was reported that the platform had only 8,000 active daily users [32], with demographics estimated to be made up of 50-60% under the age of 34 and only 33.3% female users.[33] User activity in platforms like Decentraland (or Somnium Space, or Web3-powered games like Axie Infinity) also demonstrate the same symptoms of volatility and financial speculation that we see in other corners of the Web3 ecosystem.

We have already mentioned that service providers like Shopify are driving Web3 adoption by extending their platform to facilitate token transactions, lowering the bar for businesses to deliver 'Web2.5' consumer experiences. The metaverse equivalent of such a gateway for adoption could be real-time game engines, that is, the software tools that are used to develop most games and immersive experiences.

An indication of this appeared in March 2023, when Unity 3D (one of the two most popular game engines) added a decentralised category to its asset store. Developers working with the Unity 3D engine can access the store to find tools and assets that save development time and resources. It remains to be seen how much impact such tools will have towards adopting Web3 principles among developers, but certainly the fact that Web3 wallets like MetaMask now provide a software development kit (SDK) for Unity lowers the barrier for entry for developers, and is likely to foster more experimentation. While the road towards broader consumer adoption is still long, such tools help in paving the way.

Business models emerging through convergence

A company's business model is the blueprint for how it operates, and when a Web 2.0 or immersive company starts pursuing business ideas that tap into the metaverse or Web3 principles, they need to adjust their ways of operating or pivot completely.

Building connections between these two sets of phenomena and their related technologies is where opportunities for new business models and user and community empowerment lie. We encourage thinking about practical ways in which the metaverse-Web3 convergence can become tangible as products and services, for example:

- Starting to build or use decentralised services

- Adopting generative AI tools to assist in metaverse-related content production processes

- Adopting technologies like the internet of things to connect data from the physical world with immersive interfaces, for example on a factory floor[34]

- Bypassing traditional payment solutions for direct sales via cryptocurrencies

- Adopting smart contracts and tokens to manage assets

- Launching a distributed autonomous organisation (DAO) which operates with consensus mechanisms in line with the Web3 principles

In the next section of this report, we highlight how UK companies are approaching the potential for new business models. The question about new business models relates to how the dominant Web2 companies adopt them. Companies like Meta, which has invested billions into owning the metaverse market via consumer hardware (especially VR headsets), seem to be in no hurry to shift their business models away from harvesting user data for the advertising market. In his 2023 story about VR headsets published in The Verge, Alex Heath says "Meta is planning to rely on its existing business model of advertising to help it make money off these future devices."[35]

Metaverse-driven use cases for convergence

A tool for identifying convergence

The radar metaphor has been widely employed in technology research to probe how and if technologies move from periphery to mainstream adoption. Our visualisation of metaverse-Web3 convergence helps to identify how it is evolving by applying the radar metaphor in a similar way.

The model positions the principles of the metaverse uppermost, reflecting that metaverse applications often present concrete, visible means to interact with information, whether in the shape of virtual worlds, 3D assets, or augmentations to the physical world. The lower half includes the underlying Web3 infrastructure and its principles, as defined earlier. The technology behind Web3 principles is often less visible to the end-user, yet provides the critical infrastructure for the transactions and flow of information that are initiated in metaverse, mobile, or web contexts.

METAVERSE

Networked
and data-driven

Content, asset
and service-driven

Immersive
and social

User-centred
and empowering

GENERAL   SPECIFIC   CONVERGENCE   SPECIFIC   GENERAL

Decentralised
and secure

Trustless

Public and
permissionless

Creating value
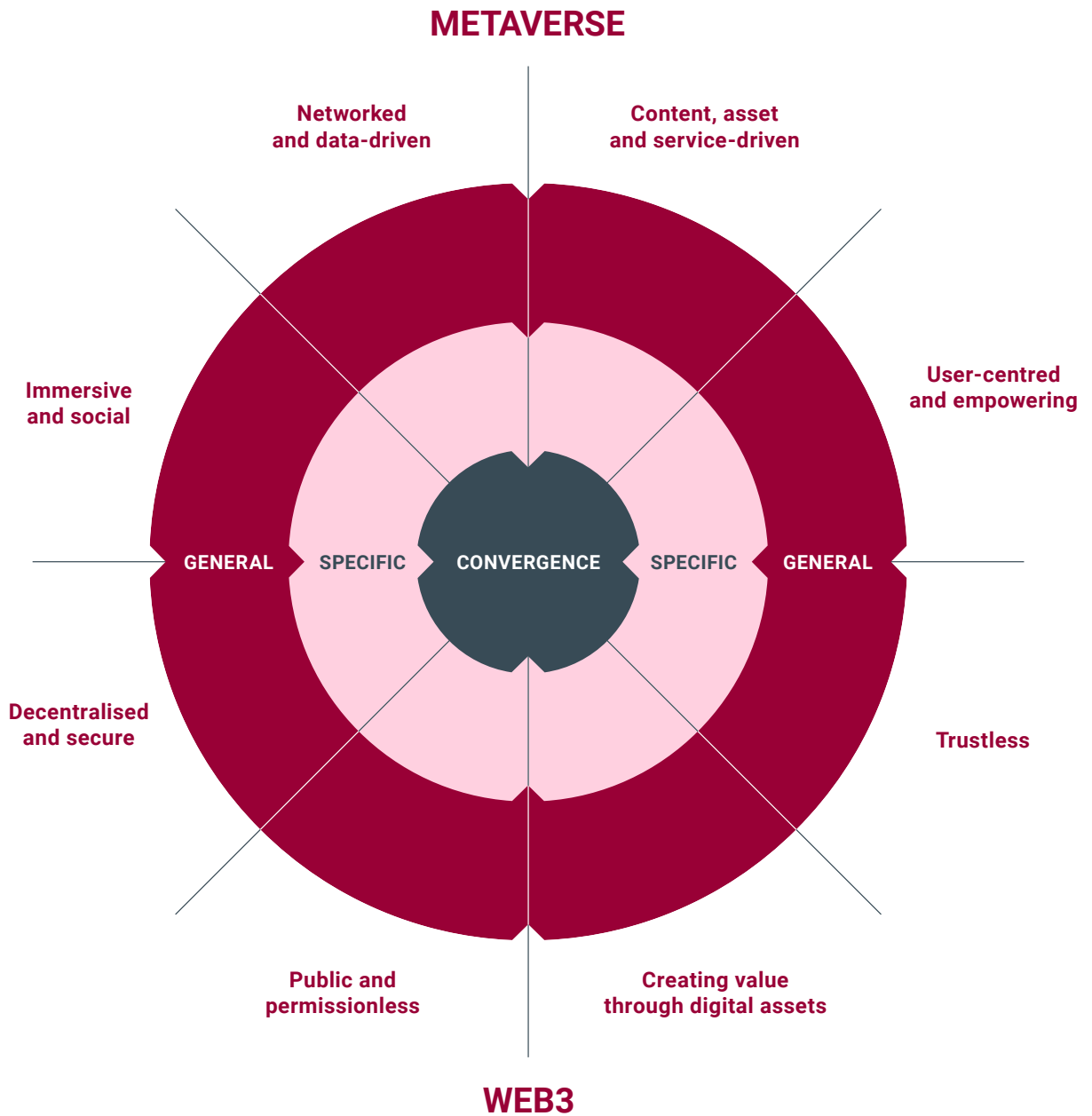through digital assets

WEB3

Figure 3.
Metaverse and Web3
convergence and principles

The metaverse-Web3 convergence model functions as a tool for identifying the individual principles of a product, service or technology, and what types of business and user needs it might enable.

The principles for metaverse and Web3 divide the model into sectors, enabling a separate focus for each. The more specific the implementation of the principles, the closer placement will be towards the centre of the circle (which narrows from general to specific to convergence).

———————

Metaverse-Web3 convergence is found when a product, service or an application has qualities in two or more sectors in both top and bottom halves of the model. In such cases, one can imagine or draw a vector in a sector in the top half that points to a sector in the bottom half, or the other way around.

This visualisation encourages thinking about ways to find vectors of convergence. For example, a non-fungible token (an NFT) is an example of a practical application in the sector about digital asset-based value creation, and the business concept would reside in the second 'specific' circle. If the token is employed in an immersive augmented reality application, that would constitute a convergent example that brings together the AR application as a 'real-world metaverse' instance, enabling users to access and benefit from Web3 principles such as security and verifiability.

A tool for identifying challenges

The metaverse-Web3 model can also be used to identify challenges and risks using a **What if?** approach when looking for convergence.

To help with ideation and discussion, Figure 4 presents the radar model as a worksheet, with descriptions and examples of topics and technologies in each sector. This can be used as a thought- or discussion-starter for how a high-level concept could be refined to become something more specific.

For example:

———————

How would users' willingness to spend money change when engaging with a service built on trustless Web3 principles?

———————

How would an augmented reality app leverage tokens, and to what purpose?

———————

Examples of how this worksheet can be populated with ideas and questions are shown in the following section.

METAVERSE

Networked and data-driven

Content, asset and service-driven

Immersive and social

User-centred and empowering

GENERAL · SPECIFIC · CONVERGENCE · SPECIFIC · GENERAL

Trustless

Decentralised and secure

Public and permissionless

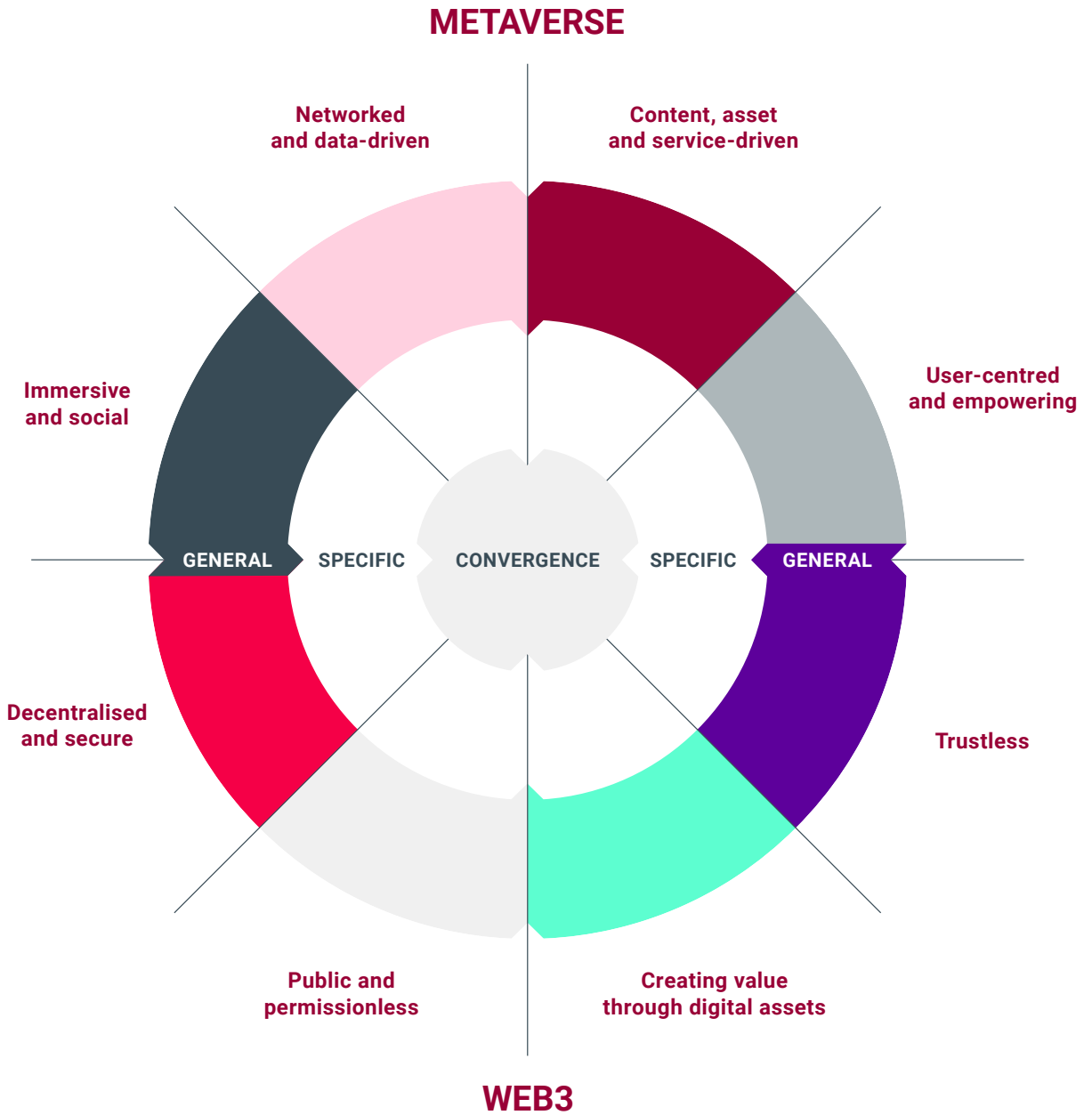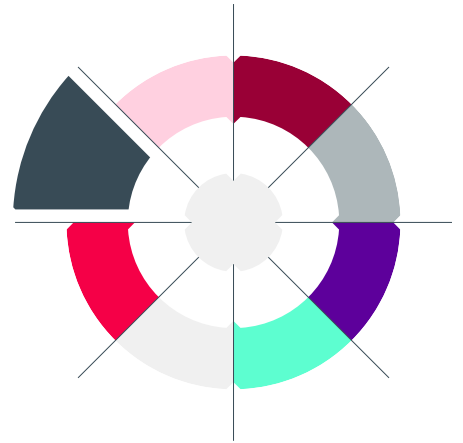Creating value through digital assets

WEB3

Figure 4.
The metaverse-Web3 convergence model
as a worksheet for ideation purposes

Segment: immersive and social

This covers the next-generation ways of accessing the internet, including embodied and spatial, and the convergence of physical and virtual worlds.

- Mobile apps

- Web

- Virtual worlds

- VR

- AR

"The development and operation of immersive digital and often three-dimensional simulations, environments, and worlds where in users and businesses can explore, create, socialize, and participate in a wide variety of experiences (e.g. race a car, paint a painting, attend a class, listen to music), and engage in economic activity."
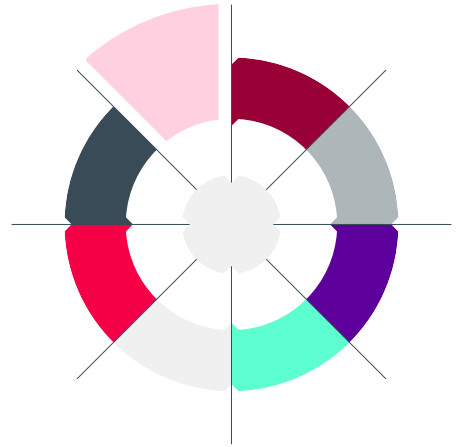
Matthew Ball, 2020

Segment: networked and data-driven

The provisioning of persistent, real-time connections, high bandwidth and decentralised data transmission.

The computing power to support the metaverse, including physics calculation, rendering, data reconciliation and synchronisation, artificial intelligence, projection, motion capture and translation.

- Interoperability protocols

- Neural networks

- Virtual production

- Real-time game engines

- Content distribution networks

- Cloud rendering

- APIs

- Machine learning

> "The tools, protocols, formats, services, and engines which serve as actual or de facto standards for interoperability, and enable the creation, operation and ongoing improvements to the Metaverse."
>
> *Matthew Ball, 2020*

Segment: content, asset and service-driven

Accessed through various public and commercial services.

- Digital identity

- Digital records

- Virtual goods

- Avatars

- Content
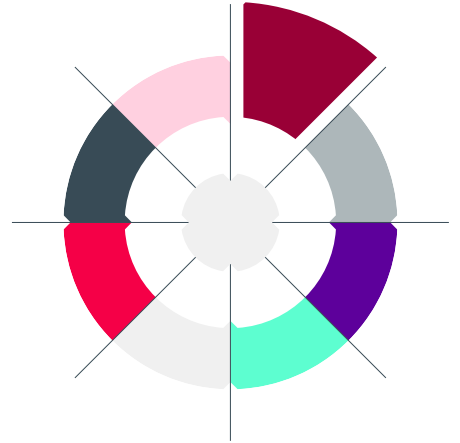
> "The design/creation, sale, re-sale, storage,
> secure protection and financial management
> of digital assets, such as virtual goods
> and currencies, as connected to user data
> and identity."
>
> *Matthew Ball, 2020*

Segment: user-centred and empowering

Users should be motivated to engage by a clear sense of empowerment or fulfilment of needs as an outcome.

- Spending money

- Time and attention

- Content creation

- Sharing with others

- Community/civil participation
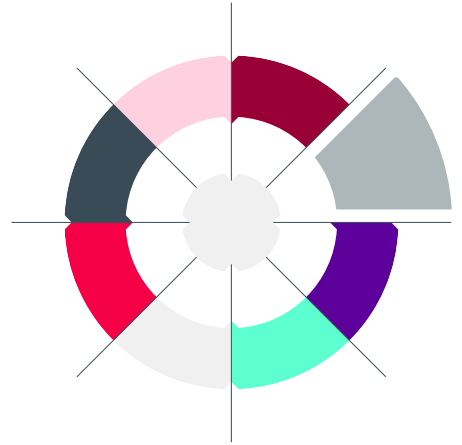
> "Observable changes in consumer and business behaviors (including spend and investment, time and attention, decision-making and capability) which are either directly associated with the Metaverse, or otherwise enable it or reflect its principles and philosophy."
>
> *Matthew Ball, 2020*

Segment: trustless

Web3 operates using incentives and economic mechanisms without the involvement of trusted third parties such as banks.

Platforms are owned by collectives, using tokens that act like shares in a company. Distributed autonomous organisations (DAO) enable a community to coordinate decentralised ownership of a platform and make decisions about its future.

- DAOs

- Verifiable

- Less trusted fast chains, like EOS

- Second layer scaling systems, such as Polygon or Arbitrum
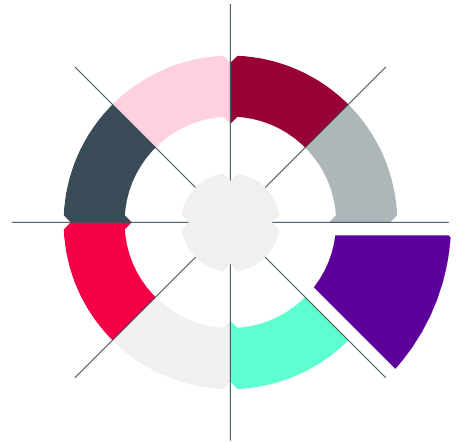
Segment: creating value through digital assets

Instead of relying on the infrastructure of banks and payment processors, Web3 uses cryptocurrency/ other tokens or assets for spending and sending money online. The user community assigns value to the tokens through their actions.

- Decentraland with its MANA token

- Virtual currency (similar to Fortnite's V- Bucks)

- Tokens

- Cryptocurrency

- NFTs
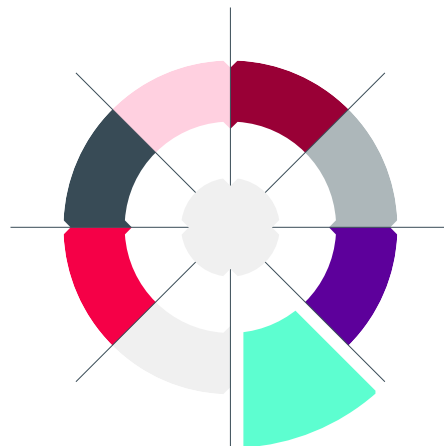
Segment: public and permissionless

All transactions, smart contracts and data are recorded on a public ledger and can be viewed by anyone, promoting trust, transparency and fairness among users.

Permissionless means that anyone can access and participate in the network without the need for any prior authorisation or permission. On permissionless blockchains, participation is not controlled by an administrator. Anyone can participate in the consensus and validate the data.

- Platform owner/censorship resistance

- Semi-permissionless systems (such as — Twitter's hexagonal avatar, neural networks)

- Mastodon or LBRY (a decentralised digital library)
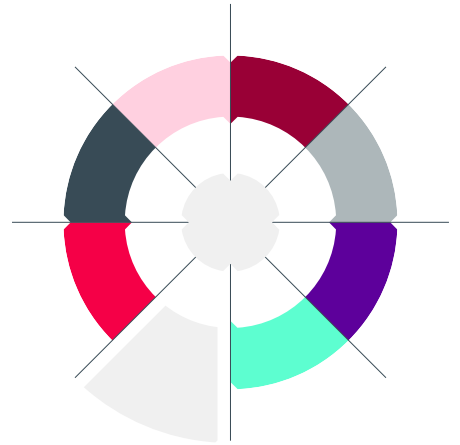
Segment: decentralised and secure

Instead of relying on centralised entities to control and manage data, Web3 allows a distributed network of computers to collectively maintain and verify the integrity of the system. This promotes sovereignty: users have full control of their personal data and digital assets.

Web3 uses cryptography to ensure the integrity and confidentiality of data, while DLT ensures tamper-proofing and immutability of data, making it difficult for malicious actors to alter or corrupt the system.

- Bitcoin Layer 1

- Hardware wallets (such as Trezor and Ledger)

- IPFS or Arweave

- Enterprise DLTs (such as HyperLedger)

- Self-sovereign identity
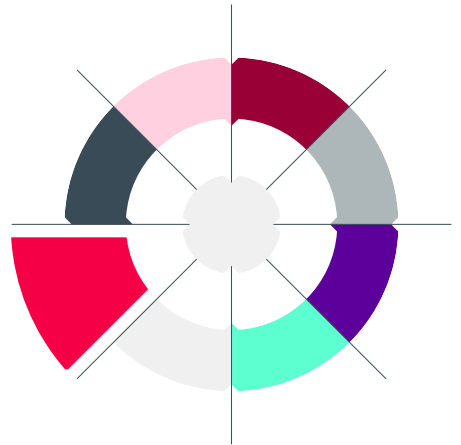
The UK landscape

- Observations from the field

- The reality: business models, challenges, segments

The UK landscape

Web3: the future of the internet

————

This chapter summarises the results of our empirical research with the UK companies we engaged with in the workshops described earlier. We recorded participants' views and analysed discussions with the goal of finding common themes relating to challenges, risks and concerns, as well as opportunities and new business models.

————

Participant attitudes towards the metaverse and Web3

At the beginning of the workshops, we invited participants to express their sentiments about each, by capturing the first three words that immediately came to mind. We visualised their responses, based on frequency.

The metaverse

MONEY

READY PLAYER ONE

CONNECTED

OPPORTUNITY

VIRTUAL

FACEBOOK

VIRTUAL REALITY

HYPE

SPATIAL

IMMERSIVE

SOCIAL

FORTNITE

ROBLOX

AVATARS

TRACKING

CONFUSION

GAMING
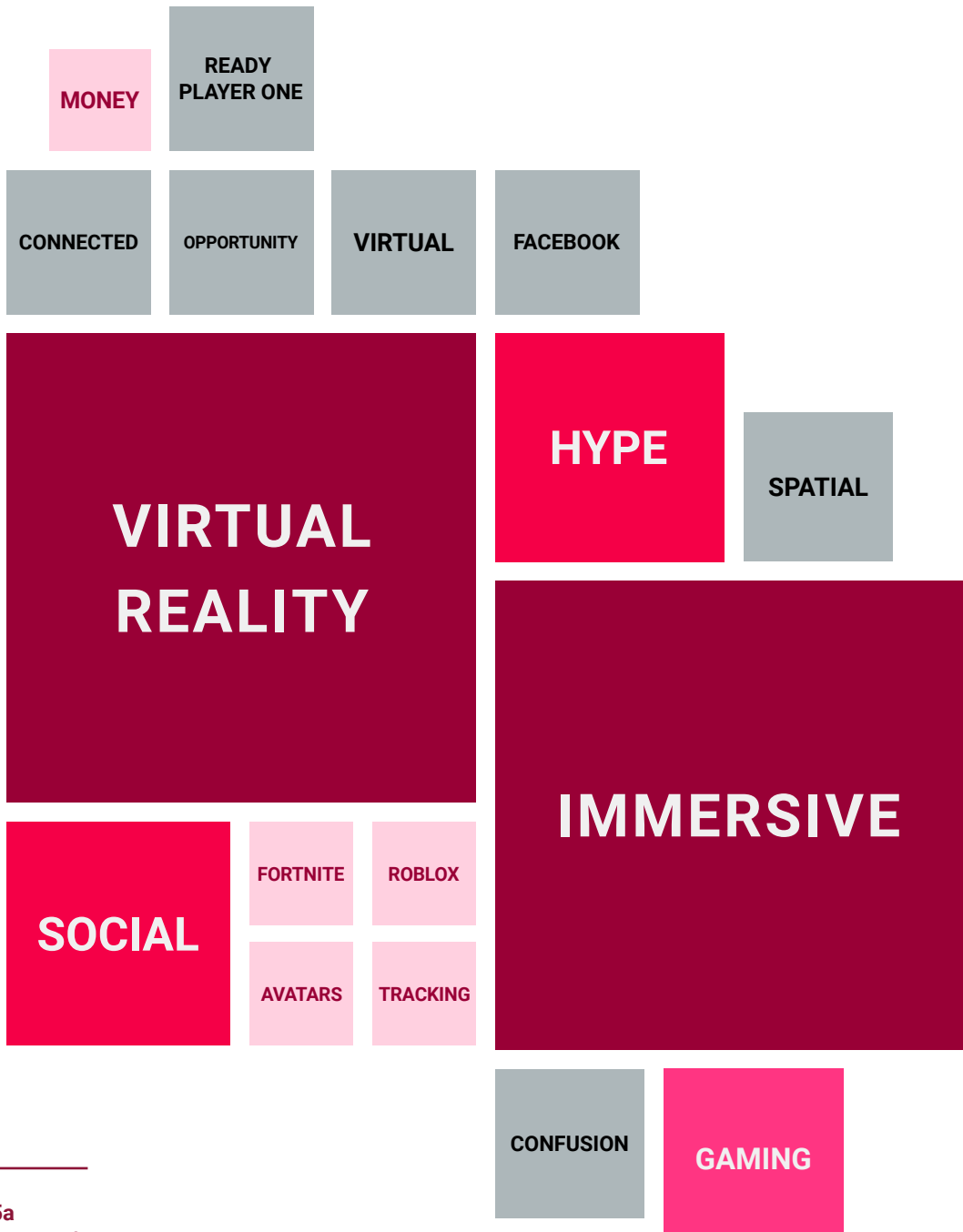
Figure 5a
Visualisations of participant sentiments — the metaverse

Web3

GRIFT

NFTs

SCAM

ARTIFICIAL INTELLIGENCE

SECURITY

COMPLEX

OWNERSHIP

BLOCKCHAIN

DECENTRALISED

TRUST

OPEN

FAIR

EVOLUTION

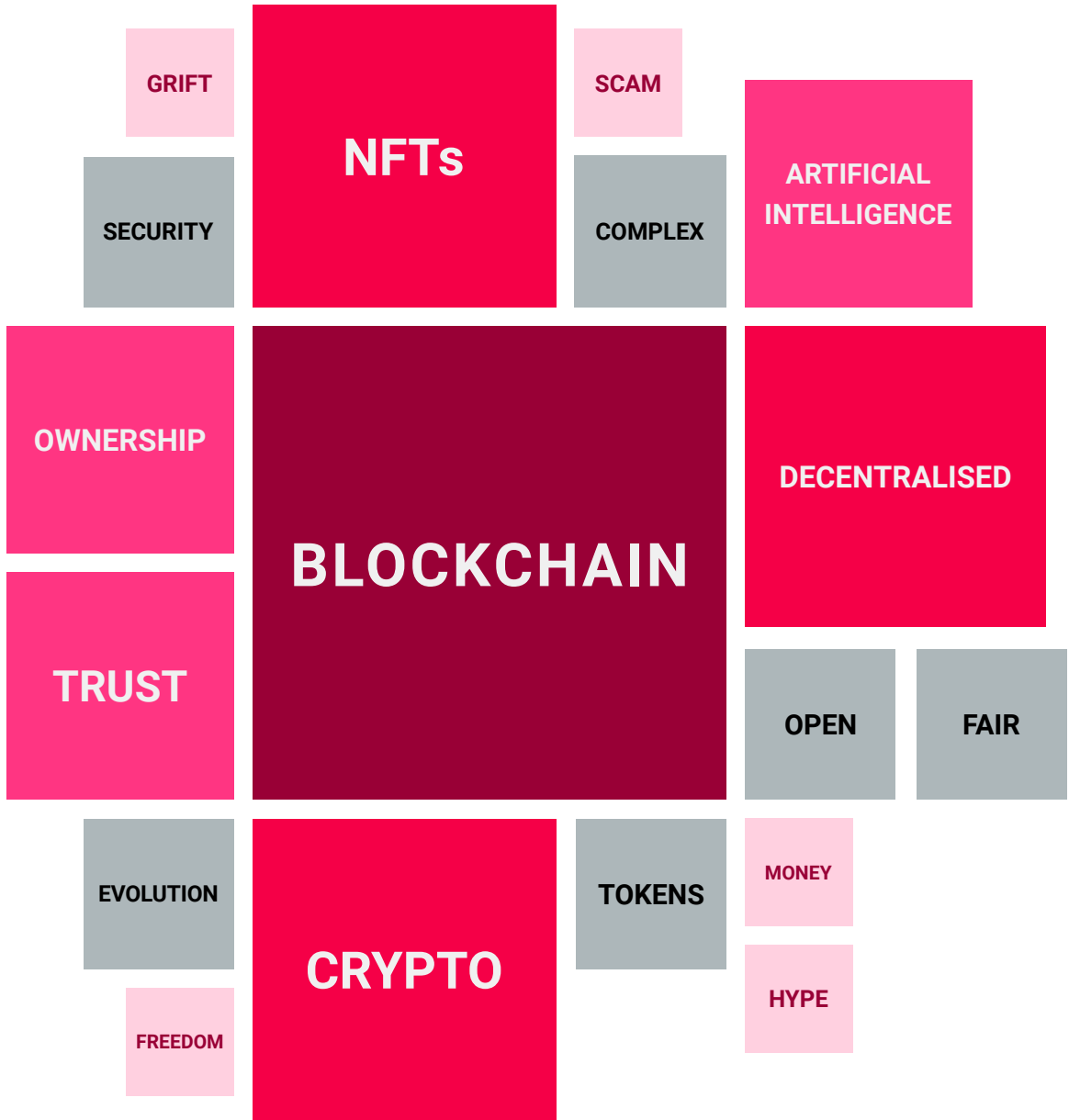CRYPTO

TOKENS

MONEY

HYPE

FREEDOM

Figure 5b
Visualisations of participant sentiments —
Web3

These results show that Web3 is perceived as a more coherent field, with a handful of concepts showing prominence: blockchain, decentralisation, cryptocurrencies and ownership. There are mentions of NFT, AI and openness, as well as expressions of scepticism.

The metaverse results are more fragmented, validating how vague the term is. However, it is clear that the metaverse is perceived as immersive, accessed via VR, an opportunity, connected and collaborative — while also being seen as confusing, undefined, and a hyped pipe dream.

Convergence model workshop outputs

Our What's on your radar? exercise was designed to help workshop participants express their thoughts, ideas, and concerns regarding *the metaverse* and Web3 principles.

We collated the results of this activity and reformulated the responses into questions, shown in Figure 6 (on the following page). This provides a snapshot of how this sample of UK companies operating across immersive and interactive media and software were thinking about convergent metaverse and Web3 opportunities in early 2023.

METAVERSE

Networked and data-driven

Content, asset and service-driven

Immersive and social

User-centred and empowering

How might we implement peer validation of the quality of data?

How might we support prolonged income from content creation?

How might we enable personalisation?

How might we live with digital mortages?

How might we facilitate intimate connections between performers and audiences?

How might we use WebXR as a content delivery channel?

How might we offer immersive site inspections?

How might we offer 'try before you buy'?

How might we faciliate voting for and financing a project with tokens?

How might a decentralised green metaverse operate?

How might we create a virtual Airbnb?

How might we reach mass scale cooperation?

How might we implement proof of humanity?

Trustless

Decentralised and secure

How might we run public borderless auctions?

How might we create reputation tokens?

How might we distribute and validate training certificates?

How might we use interoperable assets?

Public and permissionless

Creating value through digital assets

WEB3

Figure 6.
Visualisation of workshop outputs using the metaverse-Web3 principles

The reality: business models, challenges, segments

Risks and concerns in pursuing the opportunities

The impacts of decentralisation are difficult to predict. In our workshops, concerns centred around questions of identity and ethics, and when considered in the context of convergence, become increasingly complex. Safeguarding services that operate in metaverse-Web3 convergence will need to address concerns about the embodied aspects that technologies like VR create,[37] and also about the immutability of information and user pseudonymity that Web3 principles promote.[38]

Risks, ethics and privacy are questions of corporate social responsibility that are embedded into how businesses will operate in the metaverse and Web3. The case for new business models in the metaverse-Web3 convergence arises if companies are willing to adapt to how the metaverse principles work towards the comprehensive virtualisation and interconnection of human experiences for individuals as consumers, citizens and employees. Alternatively, new business models will emerge if companies are willing to adapt their ways of operating to the decentralising effects of Web3 principles.

"

The currently fashionable Web3 discourse tends to frame decentralisation as a panacea to a swath of social, economic, political woes. [...] A distributed network does not automatically yield an egalitarian, equitable or just social, economic, political landscape."**36**

Decentralisation: a multidisciplinary perspective
B Bodó, J K Brekke, J. K. and J H Hoepman (2021)

If becomes *when* once companies are able to capture value from the convergence, while still operating within legal regulations and ethical boundaries. However, currently there are a number of blockers that prevent such transitions to new business models.

- **Immaturity of legislation**
  Although digital assets were introduced to UK law in 2022 (enabling inheritance, for example), much of the legislation is not yet common knowledge for legal service providers. Company initiatives are stalling without access to competent legal advice and sufficient legal protection.

- **Legacy issues with government support**
  This is a by-product of the legislation issue. Our respondents had experienced problems with applying to Enterprise Investment Schemes and Seed Enterprise Investment Schemes because of their organisation's evident focus on Web3 as their core business.

- **Perceived volatility**
  When a company commits to decentralised and cryptographic initiatives, this is seen as a risk by external guarantors, and their business can be seen as a significant risk by insurance companies, who respond by increasing insurance premiums to unsustainable levels.

- **Lack of reliable workforce for hire**
  Because of a shortage of domestic expertise, companies need to reach out to contractors online, but there is a fear of getting ripped off by 'cowboys'. This is another element of risk preventing companies from building in the metaverse and Web3.

- **Integrating new revenue models with existing walled gardens**
  Building tokenised access to content is currently prohibited in the predominant mobile app and digital gaming stores. This makes it impossible to gain access to mainstream audiences via Web3 transaction models.

- **The general state of the ecosystem and market**
  "No one knows anything and most things will fail" said one of our workshop participants, comparing the current state of the market to the early days of the dotcom boom 20 years ago. There are few proven success stories with sufficient data about return of investment and best practices. The market is at times a 'wild west' and at other times a bear market, due to the coverage of catastrophic frauds in the news.

- **Lack of established terminology and focus**
  This creates unnecessary noise, communication challenges and confusion when proposing and delivering projects, especially when a client wants 'a metaverse' or 'some NFTs'.

Company profiles

We profiled our sample community of participating UK companies according to their stance towards the metaverse, Web3 and the blockers relating to both.

Builders

Builders are actively building towards the metaverse and/or Web3 promises. They see these technologies as enablers for new business opportunities that will cater to a new generation of users. They are typically involved with verticals where the metaverse has traction, such as fashion, gaming, retail or finance; or they are Web3-focused companies that have been focusing on the financial aspects. Trends point towards areas such as provenance and transparency, with the aim of proving value for other industries.

> "Proposals for Web3 and blockchain-based technologies run the gamut from supply chain solutions to remote educational tools, food provenance validation, greater transparency in health care, and energy exchanges."[39]
>
> *Web3: 2023 Tech Trends Report, Future Today Institute*

Our research shows that the UK ecosystem reflects a focus on finance (with multiple cryptocurrency exchange startups in London in particular), and it remains to be seen how it will evolve in line with the trends highlighted above.

Hesitants

Hesitants tend to work on related fields, such as Web2, games and immersive content, and/or have pursued immersive or Web3 projects in the past, but are held back by the risks related to legislation and lack of investment or skills.

This group sees the signs of potential, but is not necessarily able to translate that intuition into tangible concepts for their business. Even if they do, there is too much uncertainty for them to prioritise such projects over those that keep the company running. They typically work with the creative industries in areas such as advanced media production or content creation.

The low-level innovation taking place in the Web3 technology stack (such as the bridges between blockchains) is difficult for this segment to grasp from a business opportunity perspective, because the skill sets involved are different and the terminology is alien. We are seeing similar phenomena with other related advanced digital technologies (AR, for example), where feature sets are discussed in highly technical terms and translation is needed between what the technology does (such as 'scene understanding' in AR) into what it enables for the user (analysis of context, and an understanding of relationships between objects within a scene) and how that can be applied to business goals.

Followers

Followers are those who will adopt metaverse or Web3 technologies if their clients or everybody else in their professional peer community does so. This group also includes latecomers who have not paid attention to the technology so far, and find Web3 concepts in particular to be highly technical and difficult to grasp (similar to the Hesitants).

Followers tend to be sensitive to risk, and prefer to wait to see how the developments play out. For example, when HTML5 became the common standard for web pages there was no need to pay attention to its early iterations before the standard was mature and commonplace. Eventually it made sense to transition into using it.

Metaverse and Web3 standards, around interoperability in particular, have not reached a similar degree of maturity, and as Followers are not building at the heart of the metaverse-Web3 space themselves, it makes sense for them to follow rather than lead.

Sceptics

Sceptics doubt that metaverse-Web3 technologies are an improvement to existing solutions, have not found genuine use cases for their business, or consider the technologies or principles to be fraudulent.

Part of their scepticism arises from the political implications of decentralisation, and part from a lack of belief that the Web3 technology stack in particular enables anything that could not be achieved by improving existing solutions (such as databases) or business models (such as the advertising-driven revenue models of current social media platforms).

This group also includes technology veterans who see that the technologies are evoking the same discussions that they have been involved in relating to other technologies in the past (for example, on the topics of interoperability or decentralisation). They therefore find the current discussions frustrating and foresee the same unsurmountable blockers arising.

Our methodology does not allow us to define exact ratios, but as an indicative estimate, 20% of participants were Builders, 20% were Hesitants, 40% were Followers, and the remaining 20% were Sceptics.

At the beginning of this report we introduced a quadrant to visualise our research topics and questions. Figure 7 shows an updated version, redrawn to show where each segment sits.
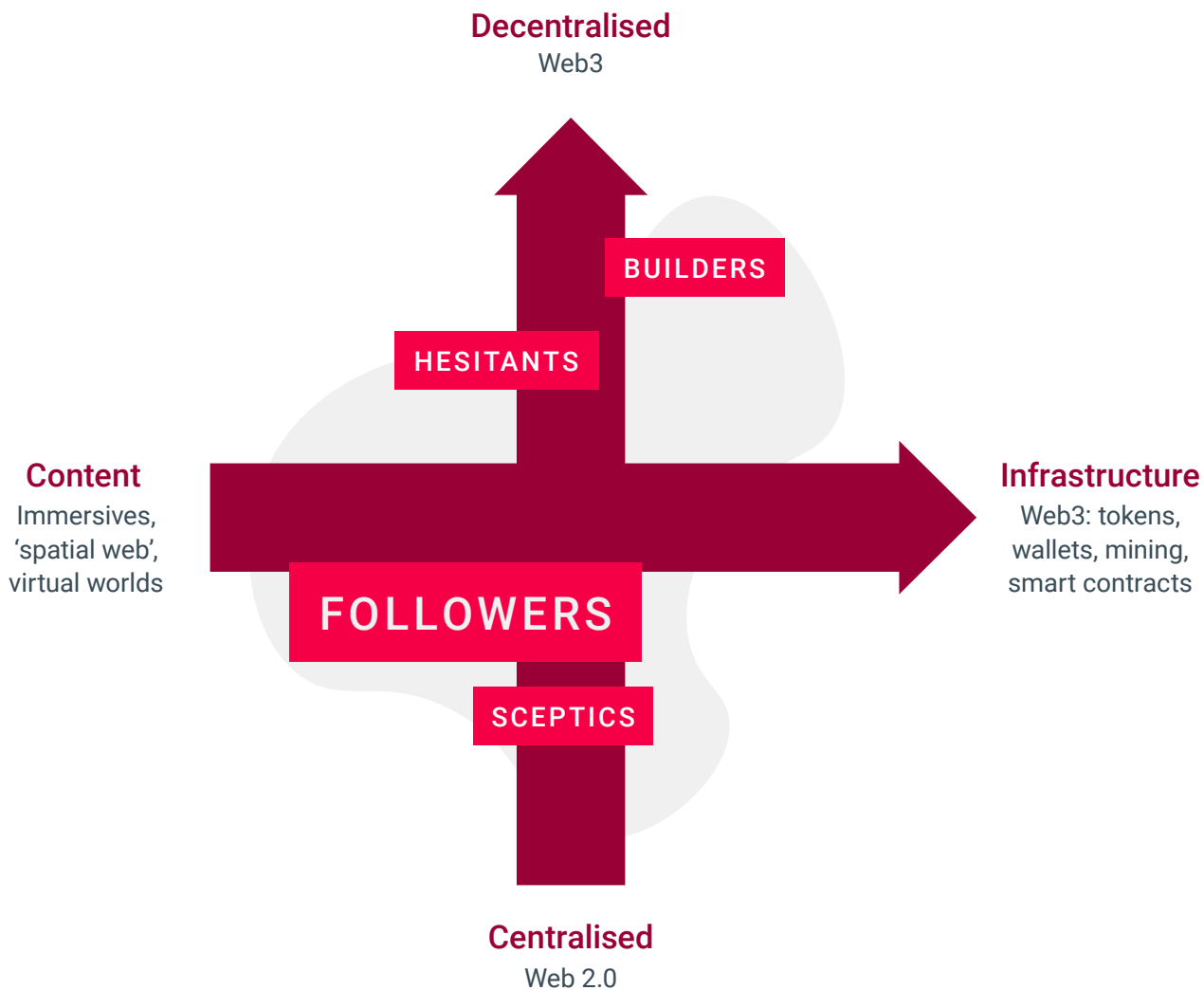
Figure 7.
Updated (post-research) distribution of UK companies'
approach to Web3 and the metaverse

Conclusion

- Who will innovate, and how?

- Supporting R&D in convergence

Conclusion

Who will innovate, and how?

Despite the high volume of ideas, thoughts and questions we collected using the radar method, most of them did not relate to anything the participating companies were actually building or planning. Whether to invest time and resources into exploring deep technologies such as metaverse and Web3 is a business choice, and one function of our data collection was finding out what kind of thinking goes into such a decision. Is it informed by calculated analyses, or by perceptions based on public discussion about the technologies (such as the news about cryptocurrency frauds, or the volatile NFT market). Or do both play a part?

While more research is needed, the interim answer is that project-based organisations that work for clients seldom have the opportunity to conduct R&D into the emerging opportunities described here, which means that they are bound to remain as followers and late adopters. Hesitants explore the opportunities and initiate projects but might not be able to carry them through (for example, because of a lack of in-house skills or contractors), or stall without the investment needed to scale initial traction. Builders tend to be startups, and according to ecosystem and market dynamics, most fail or pivot. The more volatile the field, the more often the results reflect that volatility: there may be overnight successes, but even those struggle to maintain momentum.

Supporting R&D in convergence

Hesitants are the key target for interventions that would support research and development and business initiatives. They represent a cohort that could give the market the critical mass needed for innovation, but without funding sources they will not engage. Therefore, opportunities that provide an environment for de-risked experimentation, such as targeted accelerators and funding calls, are critical to fostering innovation.

Builders will persist despite market fluctuations, but the intensity of their efforts seems to be directly proportional to the pull of the market — the outlook of broader adoption. For example, during the research period, we found multiple loosely operating DAOs in London that aim to build Web3 solutions, but given the bear market situation, their members had moved on to prioritise paid opportunities from projects in more established markets.

Facilitating collaboration between Builders and Hesitants has the potential to put both cohorts in a better position to succeed. In cases where such collaboration begins with companies that represent the divergent ends of the metaverse-Web3 axis, there is potential for innovation in the convergence.

We encourage hypotheses on product and service market fit, and suggest that the highest reach with most impact is found in concepts that bring the virtualisation of experiences on the metaverse layer together with the decentralisation of assets, applications, services and infrastructures on the Web3 layers.

Achieving equitable and sustainable convergence

Our workshop participants were predominantly white and male. While this could be due to a shortcoming in our recruitment methods, we have seen the same pattern repeatedly in related areas of technology. Given that these technologies have paradigm-changing implications, it may be that upskilling programmes geared towards expanding equality, diversity, and inclusion in this area might yield innovations and paradigm shifts that have not yet been seen or worked towards by the current demographic.

In countries with less developed infrastructure (such as banks and payment systems) than the UK, there is a greater appetite to 'leapfrog' to embrace decentralised paradigms — just as some countries leapfrogged desktop online access in favour of going straight to more affordable mobile access. This could mean that innovations in the convergence of the metaverse and Web3 emerge from such markets instead of ecosystems like the UK.

Positioning the UK as a leader in convergence

The UK has led in formulating a vision for a technological future driven by cyber-physical infrastructure, harnessing its strengths (including those of the video game industry) to drive the creation and consequential innovation of the cyber-physical future.

The Digital Regulation Cooperation Forum (DRCF) was launched in 2021 to enhance cooperation, coordination and a coherent regulatory approach across the UK's digital regulators: the ICO, Ofcom, FCA and CMA. Digital Catapult has worked closely with the DRCF to support their emerging technologies horizon, scanning efforts for the metaverse and Web3 respectively.[40] The forum is one of the first in the world to be collating insights about Web3 principles and the legislation around digital assets. However, other developed markets, such as Japan, have produced more comprehensive approaches to policy formation that also recommend investments into specific verticals (sports, entertainment) where metaverse and Web3 traction is seen already.[41]

For the UK to be a leader in these convergent technologies, further national and international collaboration is key. To improve the position of UK companies to innovate and create sustainable businesses in this space, we need a healthier tech ecosystem that fosters better connection between supply and demand of the underpinning technologies, reducing risk for the end user. We also need proven business models that encourage more innovators to get involved, not just current big tech and global luxury brands. The UK's new pro-competition regime for digital markets goes some way towards achieving this, tracking the entrenched market power of centralised monopolies to ensure that smaller businesses are not stifled by larger market powers in determining what the metaverse could and should be.[42]

Cutting through the hype is part of the journey towards achieving positive outcomes: a diverse, sustainable, secure, interoperable and equitable cyber-physical future that creates scalable use cases and business value for both supply and demand of solutions in the convergence of the metaverse and Web3. Rather than looking at narrow definitions of what the metaverse and Web3 might be individually, we should be paying attention to their capabilities, and the opportunities, risks and challenges that emerge at the point of their convergence. This is where potential truly lies.

This report provides a framework against which to map metaverse and Web3 convergence, and aims to provide companies looking to innovate in this space with some initial guidance. This is only a starting point, and for a healthy ecosystem to emerge and thrive, more guidance and opportunities to innovate are needed.

Through further practice and collaboration, the innovation, regulatory and policy implications can be better understood, enabling the UK to become a world leader in a metaverse and Web3-enabled future that is secure, ethical, responsible and interoperable.
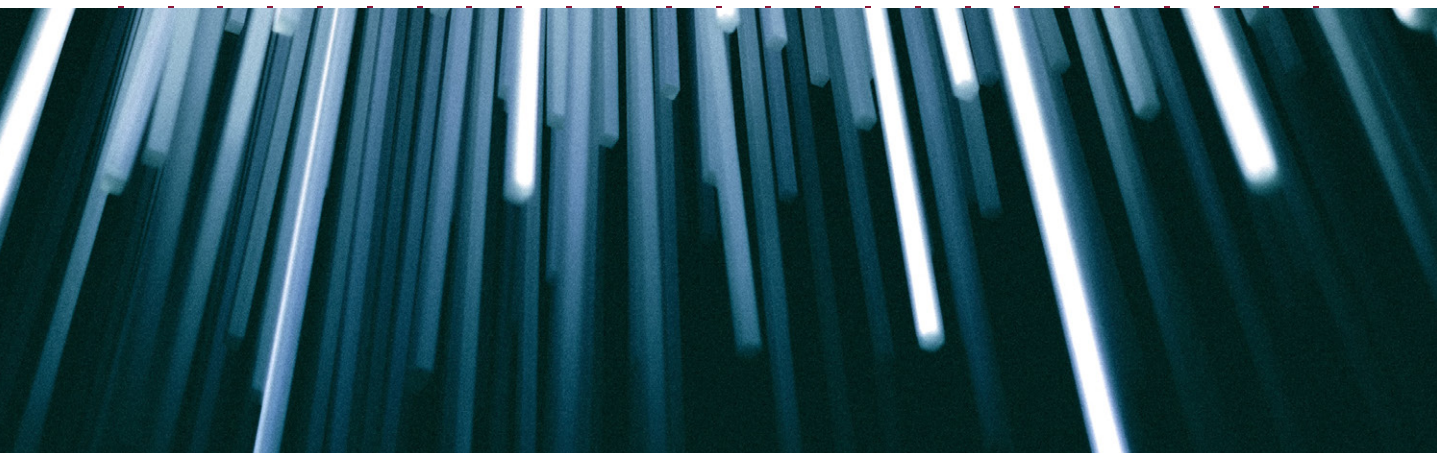
Footnotes

Footnotes

1. Digital Catapult has worked closely with the Department for Business, Energy and Industrial Strategy (now part of the Department for Science Innovation and Technology) to support innovation in CPI: **https://www.digicatapult.org.uk/expertise/programmes/programme/cyber-physical-infrastructure/**

2. Department for Science, Innovation and Technology (2023) Cyber-Physical Infrastructure Consultation Response: **https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1140202/cpi-consultation-government-response.pdf**

3. **https://cambridgesemantics.com/blog/semantic-university/intro-semantic-web/many-names-semantic-web/**

4. Robotics Growth Partnership (2022) The Cyber-Physical Infrastructure. Empowering innovation, people, robots and smart machines to enhance prosperity, resilience, sustainability and security: **https://www.gov.uk/government/publications/cyber-physical-infrastructure**

5. Criddle, Cristina (2022) "John Hanke: A real-world metaverse will be more magical than VR.": **https://www.ft.com/content/40d81fa4-67e6-40ea-b077-ba09484ba151**

6. Aloqaily, M. et al (2022) Integrating Digital Twin and Advanced Intelligent Technologies to Realize the metaverse. Mansoor.A et al (2023) metaverse Communications, Networking, Security, and Applications: Research Issues, State-of-the-Art, and Future Directions: **https://arxiv.org/abs/2212.13993** Accessed 17.3.2023

7. Digital Regulation Cooperation Forum (2022) Insight Paper on Web3: **https://www.gov.uk/government/publications/insight-paper-on-web3** Accessed 8.3.2023

8. The Guardian (2022) What happened to FTX and could the crisis spill over to the rest of crypto?: **https://www.theguardian.com/technology/2022/nov/10/what-happened-to-ftx-and-could-crisis-spill-over-to-rest-of-crypto**

9. Digital Regulation Cooperation Forum (2022) Insight Paper on Web3: **https://www.gov.uk/government/publications/insight-paper-on-web3** Accessed 8.3.2023.

10. Pentland, Alex (2022) 'Building a New Economy: Data, Ai, and Web3' in Communications of the ACM 12/2022. Vol 65. No 12: **https://cacm.acm.org/magazines/2022/12/266920-building-a-new-economy/abstract**

11. Deloitte (2022) The metaverse does not need virtual reality or web3, but they may help: **https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/technology-media-telecommunications/deloitte-uk-digital-consumer-trends-2022-metaverse.pdf** Accessed 8.3.2023.

12. Digital Regulation Cooperation Forum (2022)
     Insight Paper on Web3:
     https://www.gov.uk/government/publications/insight-paper-on-web3 Accessed 8.3.2023.

13. Bodó, B. & Brekke, J. K. & Hoepman, J.-H. (2021).
     Decentralisation: a multidisciplinary perspective.
     Internet Policy Review, 10(2):
     https://doi.org/10.14763/2021.2.1563

14. Sinofsky, Steve (2021) "Injecting New Ideas and IQ:
     The Information Superhighway":
     https://hardcoresoftware.learningbyshipping.com/p/022-injecting-new-ideas-and-iq-the Accessed 20.2.2023.

15. Ball, Matthew (2020) Framework for the metaverse:
     https://www.matthewball.vc/all/forwardtothemetaverseprimer Accessed 20.2.2023.

16. Ball 2020.

17. Deloitte (2022) The Metaverse Overview:
     Vision, Technology, and Tactics:
     https://www2.deloitte.com/cn/en/pages/technology-media-and-telecommunications/articles/metaverse-report.html

18. Moving Picture, Audio, and Data Coding by Artificial
     Intelligence: (MPAI) (2023) MPAI metaverse Model WD0.5
     https://mpai.community/wp-content/uploads/2023/01/The-MPAI-metaverse-Model-2023-01-10.pdf

19. Digital Regulation Cooperation Forum (2022)
     Insight Paper on Web3:
     https://www.gov.uk/government/publications/insight-paper-on-web3 Accessed 8.3.2023

20. **https://www.global-counsel.com/insights/report/regulating-metaverse-global-counsel-report**

21. https://www.oma3.org/,
     https://mpai.community/,
     https://www.w3.org/community/metaverse-interop/
     Accessed 8.3.2023

22. World Economic Forum (2023) Interoperability
     in the metaverse:
     https://www.weforum.org/reports/interoperability-
     in-the-metaverse Accessed 8.3.2023.

23. "Ethereum Virtual Machine":
     https://help.coinbase.com/en/coinbase/getting-started/
     crypto-education/glossary/ethereum-virtual-machine
     Accessed 8.3.2023.

24. https://www.blockplate.com/blogs/blockplate/list-of-
     bip39-wallets-mnemonic-seed

25. Deloitte (2022) The metaverse Overview:
     Vision, Technology, and Tactics:
     https://www2.deloitte.com/cn/en/pages/technology-
     media-and-telecommunications/articles/metaverse-
     report.html

26. Vayner3 (2022)

27. Vayner3 (2022) What to watch in Web3.
     8 Trends for Enterprises in 2023:
     https://vayner3.com/wp-content/uploads/2022/11/What-
     to-Watch-in-Web3-V3-November-2022.pdf
     Accessed 8.3.2023

28. See https://help.shopify.com/en/manual/products/
     digital-service-product/nfts

29. McKinsey & Company (2022)
    Value creation in the metaverse:
    https://www.mckinsey.com/capabilities/growth-marketing-and-sales/our-insights/value-creation-in-the-metaverse
    Accessed 8.3.2023

30. Transak "World's First metaverse ATM":
    https://transak.com/metaverse-atm

31. **https://dune.com/guol/Decentraland-(MANA)-token-analytics,**
    https://dune.com/awilliams/mana-dashboard
    Accessed 8.3.2023

32. **https://www.theverge.com/2022/10/13/23402418/decentraland-metaverse-empty-38-users-dappradar-wallet-data**

33. **https://www.fountetfs.com/blog/view/Why-Brands-Should-Pay-Attention-to-metaverse-Demographics**

34. IoT Analytics (2023) "The role of augmented reality in the industrial metaverse":
    https://iot-analytics.com/enterprise-ar-market-and-industrial-metaverse/ Accessed 8.3.2023

35. The Verge (2023) "This is Meta's AR / VR hardware roadmap for the next four years"
    https://www.theverge.com/2023/2/28/23619730/meta-vr-oculus-ar-glasses-smartwatch-plans Accessed 8.3.2023

36. Bodó, B. & Brekke, J. K. & Hoepman, J.-H. (2021).
    Decentralisation: a multidisciplinary perspective.
    Internet Policy Review, 10(2).
    https://doi.org/10.14763/2021.2.1563

37. McIntosh, V., & Allen, C. (2022). Safeguarding the metaverse. London: Institution of Engineering and Technology (IET): **https://uwe-repository.worktribe.com/output/10098423/safeguarding-the-metaverse** Accessed 16.3.2023

38. Digital Regulation Cooperation Forum (2022)

39. The Future Today Institute (2023)
     2023 Tech Trends report: Web3:
     https://futuretodayinstitute.com/wp-content/uploads/2023/02/Web3.pdf Accessed 16.3.2023.

40. See **https://competitionandmarkets.blog.gov.uk/2022/06/22/the-metaverse-and-immersive-technologies-a-regulatory-perspective/**

     and **https://competitionandmarkets.blog.gov.uk/2022/11/10/web-3-0-and-distributed-ledger-technologies-a-regulatory-perspective/**

41. Ministry of Economy, Trade, and Industry of Japan (2022)
     Approach to Improving Web3.0 Business Environment. From token economies to the foundation of Society5.0: **https://www.meti.go.jp/policy/economy/keiei_innovation/sangyokinyu/Web3/web3.pdf** Accessed 16.3.2023

42. **https://www.gov.uk/government/consultations/a-new-pro-competition-regime-for-digital-markets/outcome/a-new-pro-competition-regime-for-digital-markets-government-response-to-consultation**
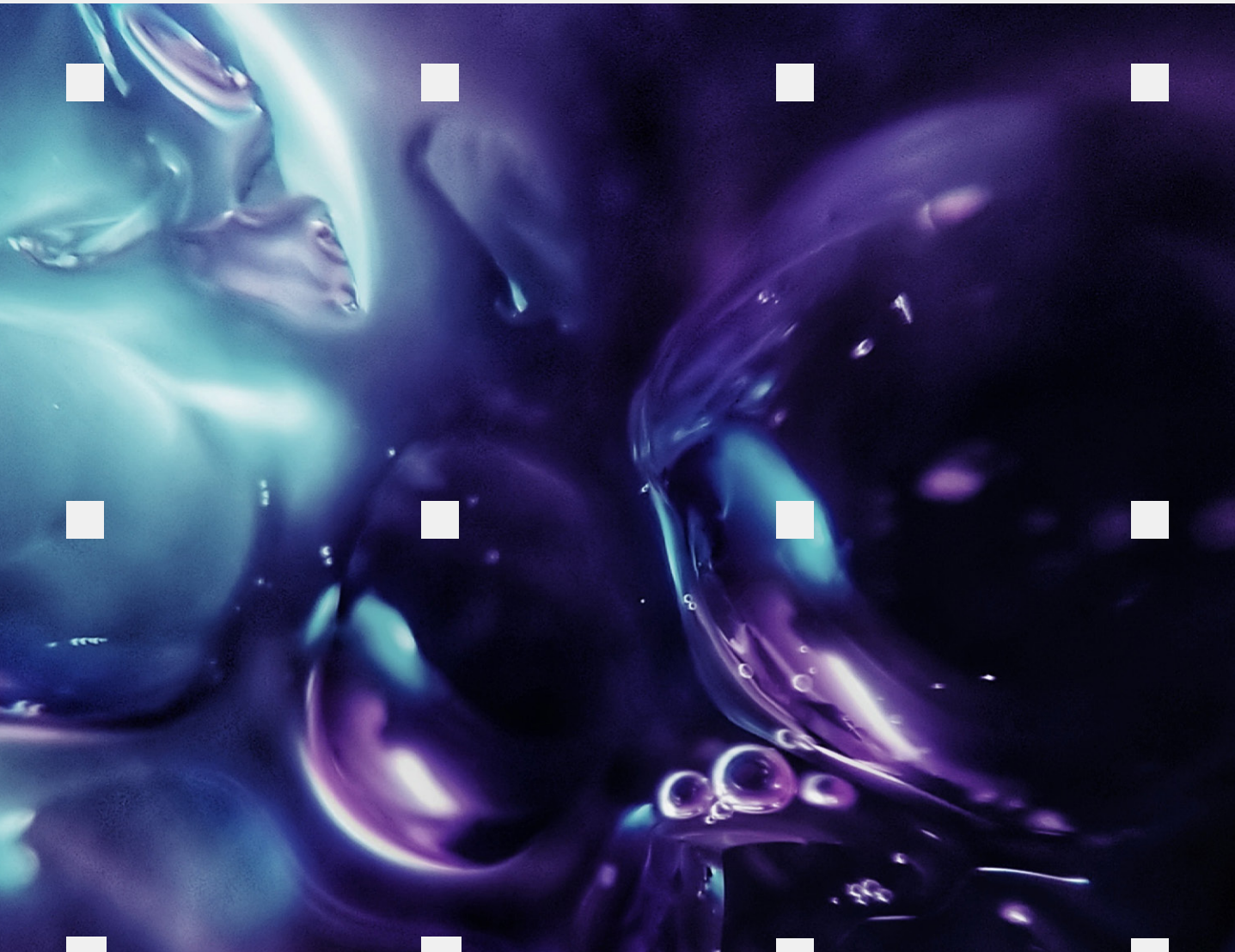
About Digital Catapult

Digital Catapult is the UK authority on advanced digital technology. Through collaboration and innovation, we accelerate industry adoption to drive growth and opportunity across the economy.

We bring together an expert and enterprising community of researchers, startups, scaleups and industry leaders to discover new ways to solve big challenges to unlock the UK's future potential. Through our specialist programmes and experimental facilities, we make sure that innovation thrives and the right solutions make it to the real world.

Our goal is to accelerate new possibilities in everything we do and for every business we partner with on the journey – breaking down barriers, de-risking innovation, opening up markets and responsibly shaping the products, services and experiences of the future.

Digital Catapult is part of the Catapult Network that supports businesses in transforming great ideas into valuable products and services. We are a network of world-leading technology and innovation centres established by Innovate UK.