

2bAHEAD ThinkTank

Digital Humans 2035

Trend Analysis
April 2023



Foreword

Dear reader,

If you're reading this trend analysis you're likely a future-minded individual who would like to find answers to the following questions:

- **What are digital humans?**
- **When will digital humans begin to have an impact on society?**
- **What role will digital humans play in the internet of the future?**
- **What kinds of business models will digital humans generate?**

This trend analysis is meant to answer those very questions. **It investigates the state of the art and makes predictions on the role of digital humans in 2035 by exploring future trends surrounding the technologies required for making our virtual representatives.** It also addresses the role of digital humans in the metaverse and proposes a number of business models involving digital humans.

In 2035, our economy will have undergone a significant transition. The ability to access, understand and analyse data will play a much greater role than today. While physical production and innovation will continue to play a key role for the economy, value generation will be complemented by activities that will occur solely in virtual environments. Enormous value can be generated through data access and analysis, as well as through the production of exclusively virtual goods.

But how will we interact with these virtual environments? Our current technologies employ screens as windows to the virtual world. We have gotten used to using mice and keyboards to work with the virtual environment. However, as human beings, this method of interaction will always remain fundamentally counterintuitive. We are three-dimensional, physical creatures, who have evolved to touch, feel and communicate using gestures and speech.

By 2035, physical and digital environments will begin to merge, and the way we interact in both worlds will no longer dramatically differ. But if you're in a virtual world, how will you interact with other people? That's where digital humans come into play.

While some respond with fear and scepticism to these coming changes, at 2b AHEAD we hope to show you that the future is understandable, exciting and full of opportunities. It is something that we can sincerely look forward to.

Enjoy reading!



Dr Harald Köpping Athanasopoulos
Strategic Foresight Consultant

Introduction: Digital Humans and the Revolution in Virtual Interaction

As AI is transforming the world around us at an accelerating pace, as of 2023 human beings still maintain the high ground of being able to definitively discern between the reality of the physical world and the artificiality of the virtual world. In our simple, usually text-based interactions with artificial intelligences, we are quite aware of the nature of our digital helpers. However, much of social interaction is not based on spoken or written language, but on facial expressions and tone of voice, on tiny gestures and subtle glances. Human beings are not naturally equipped with the capacity to mind-read, but the ability to read body language has enabled us to see beyond words, and to distinguish truth from falsehood and fake friendliness from genuine affection.

During the course of the 2020s, the rapid evolution that is occurring in the fields of machine-learning, computer graphics and extended reality hardware will cause a revolution for our interaction in virtual environments. **The future of the internet – the metaverse – will be populated by digital humans, whose appearance will be visually indistinguishable from real humans.** This will make our interaction with the digital world more natural, making full

use of the communications capacities we possess.

In this trend analysis you will find answers to the following questions:

- What technological trends will enable the advent of digital humans?
- What role will digital humans play in the digital infrastructure of the future?
- What kinds of future business models will digital humans facilitate?

What are Digital Humans?

Digital humans are computer models with the anthropometric and physical characteristics of a human (Sung et al., 2022). If they are controlled by a real human being as digital representations of their physical selves, they may be described as **avatars**. If they are controlled by an artificial intelligence, they belong into the category of **NPCs** (non-player characters). Both as avatars and **NPCs**, by the late 2020s the advent of high fidelity digital humans will have an enormous impact on society.



What Kinds of Technologies Will Enable Digital Humans?

Deepfakes

In the early 2020s, the advent of extremely convincing 'deepfakes' had caused major upheaval. While deepfakes themselves were nothing new, the hardware required to produce them became more accessible. There was a marked increase both in quality and volume of extremely convincing deepfakes, making it ever-harder to distinguish them from real video material. The Deepfake Detection Challenge was launched by Meta to create a dataset for measuring the progress on deepfake detection technology. However, **as detection technology improves, so does deepfake technology, creating an evolutionary race towards better and higher fidelity video footage** (Schick, 2020). The technology underlying the generation of deepfakes is very similar to the technology underlying digital humans. Until 2030 the trend towards ever-more realistic digital humans will accelerate.

The creation of visually convincing digital humans is enabled by the rapid advances in the following fields of technology: **computing power, computer graphics, computer animation, extended reality hardware and artificial intelligence**. The speed of progress made in all five fields or technology is currently accelerating in a non-linear fashion, contributing to the increasing impact of digital humans on the economy over the course of the 2020s and 2030s. In the section you will find a summary of the most important trends in these **enabler technologies**.

Giant Leaps in Computing Power

Until 2035, the amount of available computing power will continue to increase dramatically, permitting users to utilise highly sophisticated software using everyday computer hardware. While improvements in transistor density have begun to decelerate, **the advent of cloud and edge computing, space-based computing and especially quantum computing still pushes forward computing power by orders of magnitude** (Dunhill, 2023). Unlike classical computers, quantum computers are not limited to computing bits with the values 0 or 1, but process qubits that can simultaneously assume the values 0 or 1 as well as all values in between. The expansion of computing power is a demand-driven development, as technologies such as blockchain, machine learning and the metaverse require extremely powerful processing capacities.



Photorealism in Computer Graphics

In 2020 Epic Games revealed Unreal Engine 5 to the public. For the first time, virtual landscapes became photorealistic, with ray tracing enabling complex light reflexions in real time. The significance of this development cannot be overstated, as photorealism in computer graphics provides the foundation not only for more lifelike video games. Unreal Engine 5 can be used for the movie industry as well as for the creation of 3-d virtual environments. Epic Games' MetaHuman Creator permits users to create high-fidelity digital humans in minutes, which can then be exported to applications using Unreal Engine 5 (see Fang et al., 2021). Epic Games' graphics engine is entirely open source and **over the course of the 2020s, the further enhancement of computer graphics will make photorealistic graphics appear everywhere, as the creation of digital worlds has become faster, easier and more accessible.** At the same time, companies such as AMD, Intel and especially Nvidia are currently leading the way into the future of graphics processing, with transistor densities increasing according to Moore's law and units specialising on AI applications, enabling real time rendering in the metaverse (Evanson, 2022).

Lifelike Computer Animations

While tools such as MetaHuman Creator and Synthesia can already generate human faces that are extremely lifelike, both in their appearance and expressions, character animation in virtual worlds often appears clumsy, artificial and sometimes downright creepy (see page 7: uncanny valley). For digital humans to be given a truly realistic appearance, further advances in the field of computer animation are required, which in turn depend on accurate physics simulations. In 2022 alone, tremendous progress has been made, particularly in the simulation of liquids, which is very significant as it enables the mimicking of liquid-hair interactions (cf. Fei

et al., 2017). The physics of computer simulations are becoming so accurate, that we might soon enter a world where new design ideas can be tested in simulated reality within minutes (Zsolnai-Fehér, 2022, 1261). Accurate physics implies that digital humans will begin to move and interact with their environments with extremely high fidelity.



More Natural Interactions with IT Using Extended Reality Hardware

The history of human interactions with computers is a the history up input and output devices. While many of us grew up with CRT monitors, these have been nearly universally superseded by flat panel displays. However, for digital humans to become truly lifelike, they will have to be presented in environments that are most alike to the three-dimensional spaces of our everyday lives. Extended reality hardware producers like Varjo, Meta or HTC are pushing the boundaries of the field. Today's XR technology has become so advanced, that users are reporting being unable to distinguish real from virtual objects (cf. ThrillSeeker, 2022). **Until 2035, XR hardware will enable virtual environments to become ubiquitous and fully integrated into our experience of everyday life.** VR glasses will become slimmer and lighter, allowing us to access the metaverse as easily as we do our phones in the present.

The Impact of the AI Revolution on Digital Humans

The most important technology that will revolutionise both digital humans and the environments they will populate is **artificial intelligence**. In 2022 tools such as Midjourney became available allowing users to create AI-generated images using prompts in natural language. The results are often stunningly beautiful and original. According to OpenAI CEO Sam Altman and others, AI will transform the world in a way we haven't seen since the introduction of the iPhone (Bello, 2023). Machine learning will enable natural language prompts to generate not only highly realistic digital humans, but entire photorealistic worlds. Imagine telling your personal AI assistant, "I'd like to lie on a red sand beach on terraformed Mars with 0.38g." The AI will then go on generating a unique world full of surprises, even being able to bend the laws of physics that constrain the natural world – but unlike Second Life these worlds won't be empty, but they will be populated by lifelike avatars and NPCs. In the case of NPCs, AI will enable autonomous digital humans that look and interact like real humans (Sander Saar, 2021).



Digital Humans as the Virtual Population of the Metaverse

The uncanny valley

The veil is lifted: There it is, the newest model in a series of lifelike robots. At first you are fascinated and excited, but when the robot turns its head to look at you, you begin to reconsider. Its eyes do not quite meet yours, its lips are not quite in tune with its voice, the movement of its eyebrows is not quite symmetrical as they move up in the machine's attempt to smile. Your fascination remains, but you realise that something is not right. You can't tell exactly why, but your gut feeling is aversion. In 1970 Japanese robotics expert Masahiro Miro wrote an essay on this phenomenon, postulating that a person's response to a robot shifts from empathy to revulsion, as is approaches but fails to achieve a lifelike appearance (Mori, 1970; Mori et al., 2012). When robots finally become so realistic as to be indistinguishable from real humans, the issue disappears and we shift back towards empathy. **Mori described this drop in empathy as the uncanny valley.** While digital humans are qualitatively different from robots, lifelike avatars and NPCs face the same issue in the virtual worlds of the future.



The metaverse is a “persistent, live digital universe that affords individuals a sense of agency, social presence, and shared spatial awareness, along with the ability to participate in an extensive virtual economy with profound societal impact.”

Piers Kicks, Delphi Ventures

What is the Metaverse?

While the term metaverse was popularised by Meta CEO Mark Zuckerberg, the concept of open virtual worlds with their own internal economies is not new. However, the convergence of the technologies described above, as well as the emergence of blockchain technology, will enable the metaverse.

This metaverse consists not only of a particular virtual space such as Second Life or VRChat. It signifies the entirety of the three-dimensional digital environments human beings and AIs will create, including AR overlays, mixed reality blended spaces and virtual worlds. As such, **the metaverse represents the next evolutionary stage of the internet, which moves beyond screens, touchpads, mice and keyboards.** In the metaverse we will interact with people and information in the same manner we interact with the natural world today, namely through motions, gestures and speech.

The metaverse will thus allow users to utilise a greater potential of human communication tools in the digital environment, making digital environments feel deceptively natural.

possibilities of the metaverse will generate vast open spaces: forests, deserts, seas, beaches and AI-generated landscapes no human has ever dreamed off. Digital human NPCs will populate these spaces.

What Role Will Digital Humans Play in the Metaverse?

Digital humans will act as both our avatars and as data and information interfaces. **In the metaverse, we can choose to 'wear' an avatar that looks the way we do in real life, as well as being able to wear other avatars of our choosing, including non-human shapes and forms.** NPCs take over the role that many websites play in the contemporary internet architecture. Marrying couples today often create a wedding website to inform their guests about the details of the event; in 2035, they might create NPCs that look like them and who can answer any questions their guests may have. The limitless

Imagining Digital Humans in the Metaverse of 2035

In 2035, digital humans will have advanced to such a degree, that in the metaverse environment we will not be able to easily distinguish avatars from NPCs. A digital human might thus attend a meeting, without the other meeting participants being aware of their humanity. **Depending on the rules in place in this region of the metaverse, this enables 'multi-presence', i.e. being able to be in different locations and situations at the same time.** However, provided the adoption of a distributable ledger, avatars could be equipped with 'soulbound NFTs', i.e. digital tokens which undeniably prove the identity and humanity of digital humans in the metaverse. In the situation described above, the meeting participants would thus be able to identify the nature of the digital human in front of them without encroaching on their privacy; they could be an avatar controlled by the person the others presume, an avatar controlled by someone else or an AI-controlled non-player character.



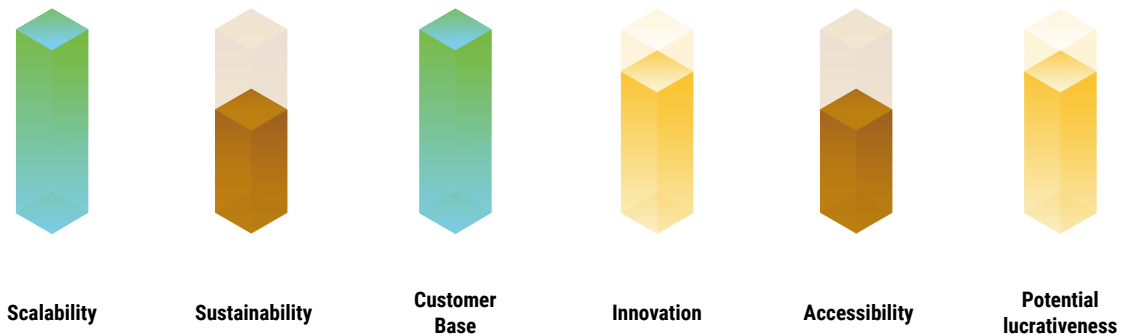


Business Models Involving Digital Humans

The critical role that digital humans will play in the virtual spaces of the future and the technological convergence that will culminate in the creation of truly lifelike digital humans gives rise to a vast amount of business models. The following is a list of possible business models involving digital humans until 2035.

NPCs as digital staff

In the present, digital humans are sometimes used for customer relations (e.g. Deutsche Telekom's Selana). Even in early 3-d virtual environments, many businesses will open digital shops to promote their physical goods and services or to sell digital products. These shops will be staffed by avatars and NPCs, which will have to be trained on the products they are meant to sell. Similarly, virtual museums could utilise NPCs as museum guides.



Main deliverables

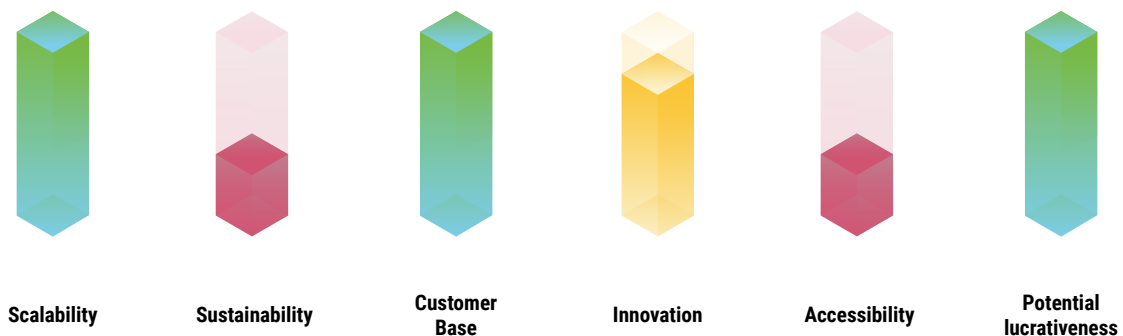
AI-controlled digital humans as staff of shops in the metaverse

Customers

Potentially all businesses with customer interaction, including B2C, B2B, B2AI, AI2AI

NPCs as personal assistants

This represents the further evolution of current 'generic' digital assistants such as Siri and Alexa. Our increasing interaction with virtual environments requires us to have a filter of digital information. Enabled by AI and the natural communication style of digital humans, NPCs will soon become our personal gatekeepers, providing us with relevant news, showing us relevant media content, sifting through our mail and booking our next train ride.



Main deliverables

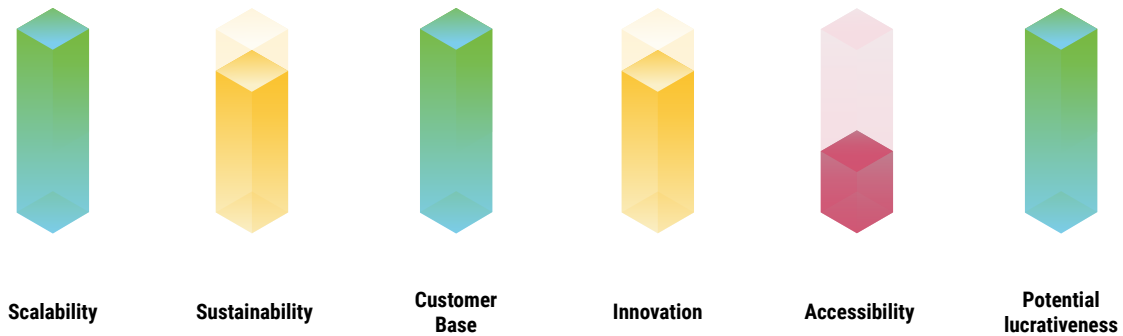
AI-controlled digital humans capable are carrying out tasks such as: scheduling, travel arrangements, news filtering, responding to emails

Customers

Everyone

Digital humans for entertainment

Digital human NPCs can be used for entertainment purposes, allowing children and adults to interact with their favourite characters from movies and books. These NPCs can be visualised using XR hardware or holography in theme parks or other entertainment sites.



Main deliverables

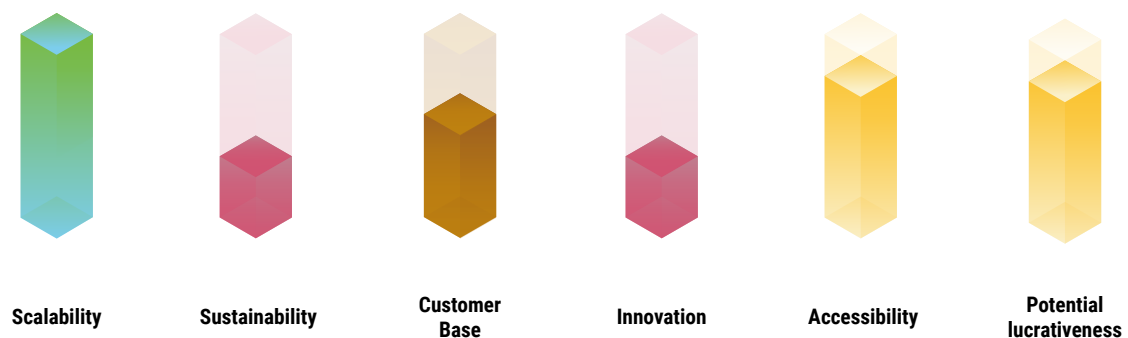
Virtual performances, interactive movies, NPCs and avatars for video games

Customers

Private individuals of all ages, music lovers, gamers, theme parc visitors etc.

Sale of NPCs

If you want to create a website in today's world, there are essentially three options: (1) you create the website yourself on a free hosting platform, which usually generates revenue through advertisement; (2) you create the website using a ready-made framework on a subscription based hosting platform; (3) you hire a web designer to create the website for you. In virtual environments, you will either be able to create digital humans yourself, you can buy a ready-made digital human or you hire a digital designer to make a digital human for you. All three options will be offered by various companies, who may also advertise by displaying their logo on their digital humans' skin and clothes.



Main deliverables

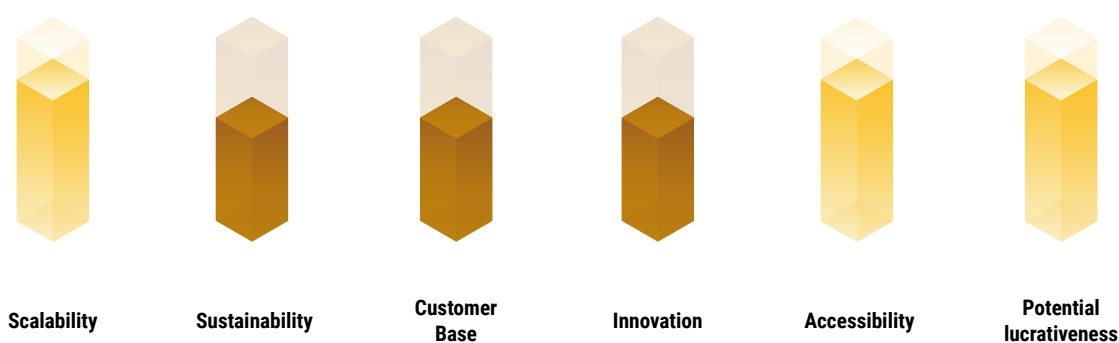
Tailored NPCs for private and commercial use, consulting on where to employ which NPCs

Customers

Businesses with customer interaction, private individuals

Sale of avatars

Within the digital infrastructure of the future, avatars will represent an important aspect of our digital identities. People will take great care of their appearance in the virtual environments, especially in a business context. For universal adoption, avatars will need appear professional and dignified, a criterion which they arguably do not fulfil yet. There is thus a business case for the sale of professional avatars. Moreover, as in the real world, different occasions require different appearances. In the virtual environments, people will want to make their avatars unique and personalised, creating a large market for digital outfits and accessories.



Main deliverables

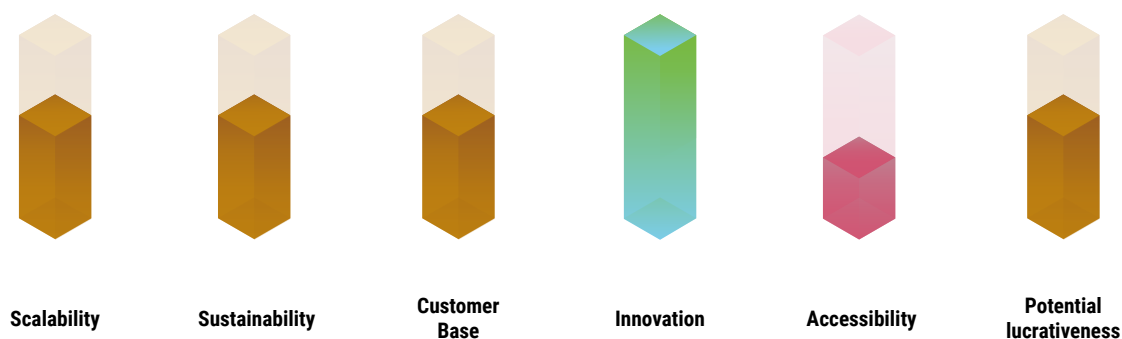
Tailored avatars for private and professional use, consulting on avatars

Customers

Everyone who seeks to engage with the metaverse, both in private and professional situations

Open-ended video games

Ever since the early days of computer games, some games featured multiple endings. However, each ending is scripted, requiring a lot of effort on the part of the producers. GPT-3 is already enabling open-ended games with limitless possibilities (Future is Now, 2021). Its successors will likely permit players to interact with a variety of AI-controlled NPCs that can react spontaneously to the evolution of the game's story line.



Main deliverables

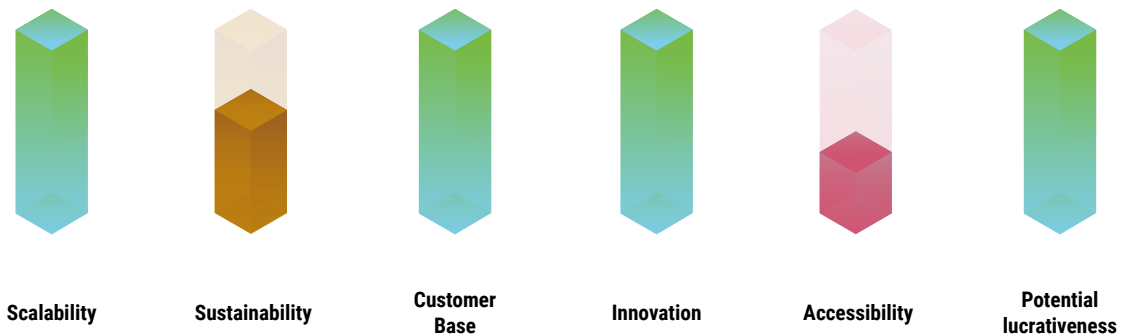
Video games

Customers

Gamers and streamers of all ages

NPCs for companionship

AI-controlled NPCs are not just there to fill the empty spaces of future virtual environments. Unlike generic personal assistants, future NPCs will serve as our companions, teachers, instructors, advisors, assistants and even as counsellors, therapists and friends. Many people will maintain enduring, perhaps lifelong relationships with AIs, although some NPCs may also possess an 'expiry date', giving them one more characteristic that makes them resemble their human creators. A future business model will involve producing, letting and selling AI-controlled NPCs for all kinds of companionship. These NPCs will not be employed for advertisement or product marketing, but to serve the customer's unique needs, generating a relationship characterised by trust and attachment.



Main deliverables

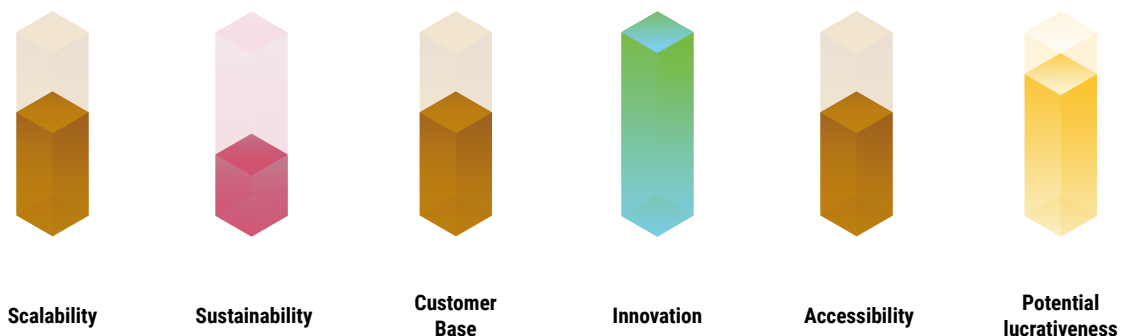
AI-controlled NPCs with unique characters,
individual consulting sessions

Customers

Everyone

Living memories

In future virtual environments, it will become possible to recreate an image of deceased friends and family members using AI and digital humans, effectively creating functional ghosts (Gruvæus, 2023). Using the footprints left behind in digital spaces, AI-controlled NPCs can be used to help bereaved people in times of grief.



Main deliverables

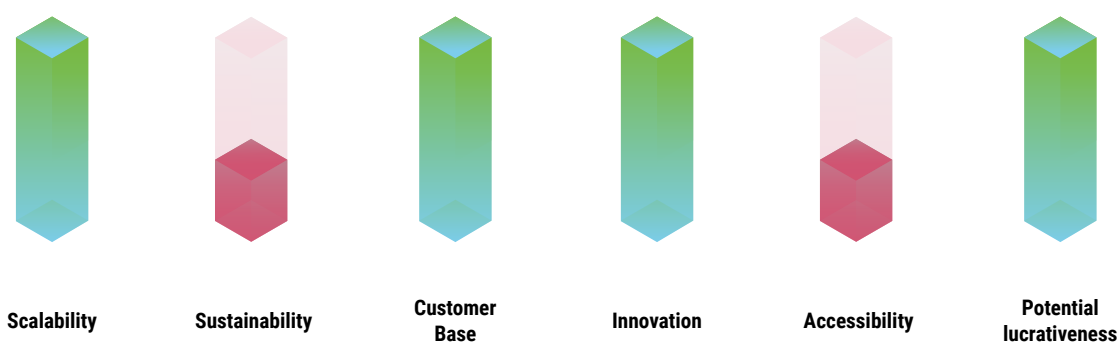
AI-controlled NPCs with the characteristics
of someone recently deceased, bereavement
counselling

Customers

Bereaved people

NPCs as personal representatives

While businesses will possess digital staff, consisting both of avatars and AI-controlled NPCs, private individuals as well as business people will retain personal representatives who will represent them in meetings, sales negotiations and other types of interaction. These personal representatives will require businesses to develop new communication strategies. The customers of future virtual environments will not only be comprised of human beings. As they become more advanced, AI-controlled personal representatives will also be capable of business transactions. Moreover, NPCs will become important multipliers for the sales promotion of physical and digital goods. As such, businesses should consider B2AI as well as AI2AI strategies.



Main deliverables

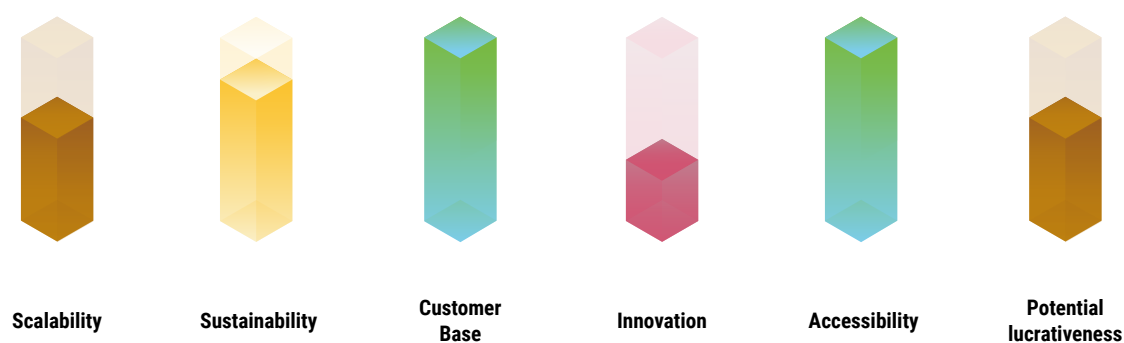
Tailored, AI-controlled NPCs mimicking the characteristics of their physical originals, consulting on using NPCs

Customers

Business people, private individuals

Proof of humanity

In the physical world, we have operationalised several physical characteristics to digitally identify human beings. Most of us use our unique fingerprints and physiognomy to access digital devices. While the same technique will still be used for access to our unique digital avatars, digital humans themselves do not possess characteristics that cannot be imitated by other digital humans. A future business model is therefore the production and distribution of soulbound (i.e. personalised) NFTs for particular avatars and NPCs. These NFTs will be what makes each digital human unique.



Main deliverables

Uniquely assigned NFTs to definitively discern avatars and NPCs

Customers

Everyone, especially in business environments

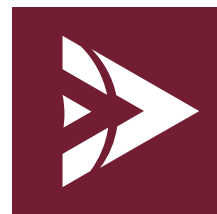
Conclusion: Questions of Life, the Universe and Everything in the Digital Infrastructure of the Future

While the evolution of virtual environments and digital humans will have enormous economic repercussions, the physical world will by no means cease to disappear. Physical human beings will continue going to school, raising their children, travelling on holiday and walking their dogs. The primary role of digital humans is to make our way of interacting with the digital world more natural, more suited to our human nature.

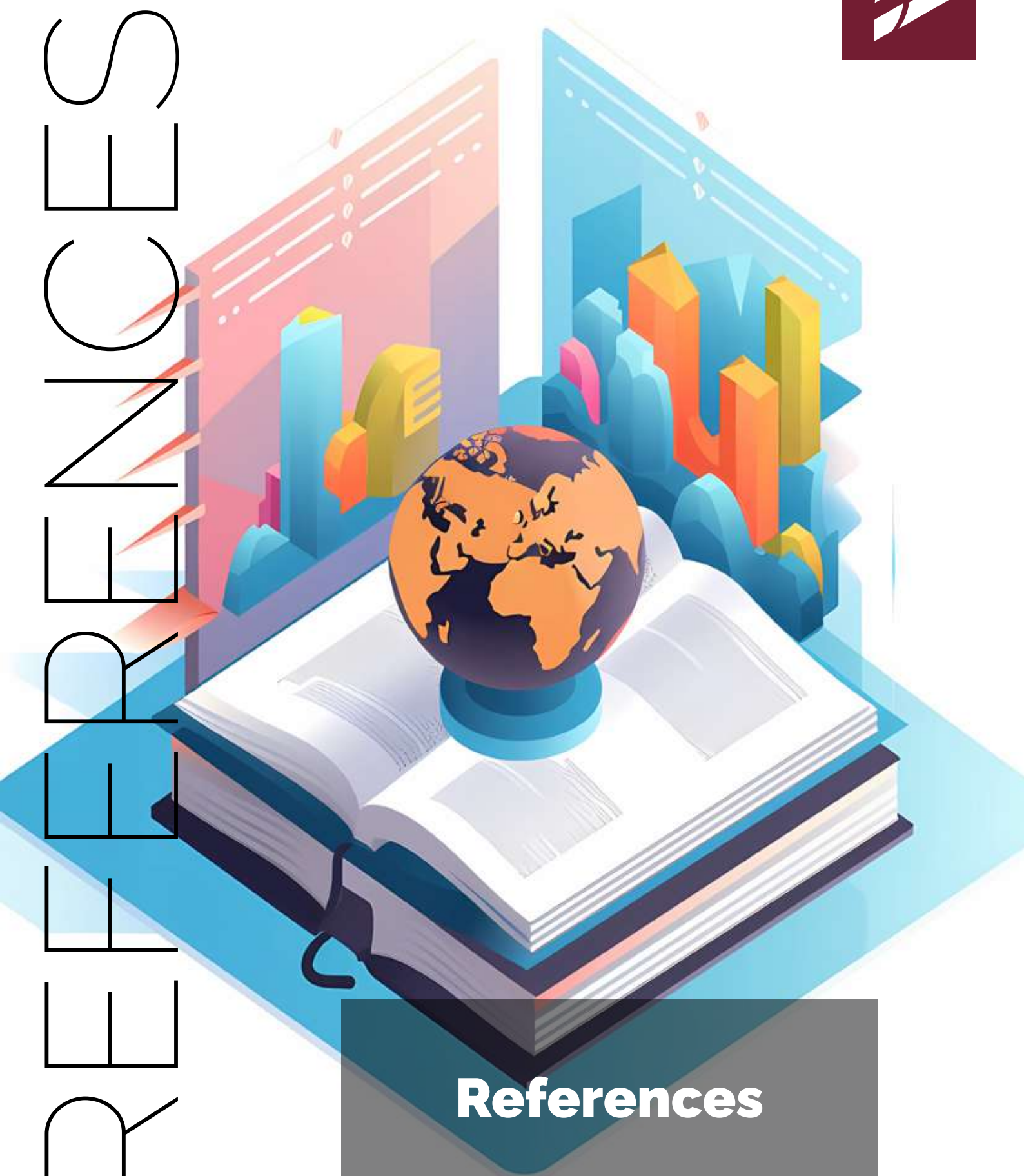
Nevertheless, the time we spend in virtual environments will not decrease. **The metaverse will cause virtual worlds to become more integrated with our everyday lives.** As the metaverse becomes ubiquitous and as digital humans begin to coexist with their physical counterparts, ethical questions concerning the nature of the new digital infrastructure will begin to arise: How can we make sure that we continue to be able to discern between physical reality and virtual reality? How can we safeguard the security of the metaverse? How can we prevent identity theft, avatar hacking and rogue NPCs? Should ethical rules be applied in the metaverse in the way they are applied in the physical world? **Is the metaverse all about 'experience', or does it leave space for introspection and spirituality?**

If we find answers to these questions, digital humans hold endless possibilities, both for businesses and for the quality of our everyday lives.





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Author

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The author of the trend analysis is
Dr Harald Köpping Athanasopoulos.

Responsible in terms of press law is the managing director of 2b AHEAD ThinkTank GmbH, Sven Gabor Janszky.
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Contact

2b AHEAD ThinkTank GmbH
Spinnereistraße 7, Hall 20 E
D-04179 Leipzig

Registered at the district court of Leipzig:
HRB 31639
Tax ID No. DE302023600

Phone: +49 341 12479610

Fax: +49 341 12479611

E-Mail: strategic-foresight@2bahead.com