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DIGITAL DEVELOPMENT AND DIGITAL FRONTIER TECHNOLOGIES: SOME CAUTIONARY NOTES

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Abstract:

This article explores the Digital-for-Development (D4D) paradigm from a critical standpoint, scrutinizing the role and implications of digital frontier technologies within the D4D paradigm. It questions the promises these technologies hold for advancing the UN's 2030 Sustainable Development Agenda. By exploring the hyperbole surrounding digital frontier technologies, the ideological underpinnings of the D4D paradigm, and the (in)compatibility of these technologies with established Digital Principles, the article aims to foster a more nuanced and critical approach on the integration of cutting-edge technological innovations in development initiatives. The article proposes a shift towards more community-driven, democratic, and human rights-oriented approaches in utilizing digital frontier technologies for development.

Keywords:
Digital-for-Development, frontier technologies, ICT4D, international development

Introduction

Technology has always been a cornerstone in the discourse of human progress. Technological paradigms and accelerations, historically, have also caused strong polarizations in society. Two-hundred years ago, in the beginning of the Industrial Revolution, a community of textile workers feared that the newly introduced cost-saving machines were taking their jobs. These machines were now doing the work, cheaply and less artfully, that had for generations formed the foundation of their lives and their communities (Merchant 2023). The unrest initiated by them came to be known as the Luddites movement. In the aftermath of World War II, Truman's inaugural address advocated for leveraging the benefits of technical knowledge to improve lives, a sentiment that has persisted in development discourse. This ethos reemerged in the Millennium Development Goals, specifically MDG 8, Target 8.F, advocating for the dissemination of new technologies, especially in information and communications. It continues with the Sustainable Development Goals (SDGs), where technology is seen as integral across numerous SDGs. With the invention of the Internet and world wide web new horizons and paradigms opened for the world, revolutionizing communication, commerce, international cooperation and development, and access to information. As the Internet was constantly looking to expand its applicability in other parts of the world and sectors, the development sector was seeking to deploy new Internet

inventions in the Majority World as a solution to help those most in need. It was an organic marriage between the two during the period of dot-com boom. This marriage grew as a field of research and practice under the umbrella of Information and Communications for Development (ICT4D).

Following Richard Heeks' classification of ICT4D periods/paradigms (Heeks 2019), we can trace the evolution of ICT4D as follows:

1. *Pre-digital paradigm*, referred also as ICT4D 0.0, which spans from mid-1940s to mid-1990s and predates modern technologies.
2. *The ICT4D paradigm*, which includes: ICT4D 1.0 covering the period between mid-1990s until mid-/late-2000s and it is centered around the concepts of internet-connectedness and telecentres; and ICT4D 2.0 which encompasses the period between mid-/late-2000s until the present times and it represents, perhaps, the peak of deployments of ICTs in development. This period is accompanied also by the rise of Web 2.0..
3. *Digital-for-development paradigm*, also referred to as ICT4D 3.0, emerged in late 2019. It is associated with reproduction, diffusion, mutation, and intensification of the dominant mode of the competitive markets, and hierarchical controls associated with capitalism and with traditional state-citizen relations. Simultaneously, the paradigm is also associated with growing examples for an alternative economics and an alternative politics (Heeks 2019).

This article aims to engage with the Digital-for-Development (D4D) paradigm from a critical studies perspective—from theoretical concepts to its practical applications. In the light of fast-growing popularity of *frontier technologies* that guide, mediate, and shape D4D paradigm, this article seeks to answer to the following questions: In the context of a 'polycrisis,' characterized by the tangled intersection of multiple crises occurring simultaneously, does the promise of digital frontier technologies represent a genuine opportunity or merely another example of overselling hyperbole? What are the political and ideological implications, considerations, and entanglements between the D4D paradigm, private tech firms, and the UN 2030 Sustainable Development Agenda? How can the D4D paradigm evolve and reorient itselv to prioritize community-driven, democratic, and human rights-centered approaches in the deployment of digital frontier technologies?

The article, therefore, elaborates on three broad areas of contention to foster more rigorous

discussion; specifically: 1) recognizing the hyperbole of the digital frontier technologies and their worldwide operationalization through *futuring*, *scaling* and *deterritorialization*; 2) understanding the ideological nature of D4D paradigm and its intersection with digital frontier technologies; 3) acknowledging the (in)compatibility of the digital frontier technologies with D4D paradigm. This article is positioned as a transdisciplinary theoretical inquiry, integrating insights from a variety of disciplines including science and technology studies, philosophy of science, development studies, social design, and digital social innovation. The draws from a diverse range of scholarly works and publications from the aforementioned disciplines to construct a comprehensive analysis. By weaving together these varied strands of scholarship, the methodology aims to uncover and question the underlying assumptions, values, and potential impacts of the Digital Development (D4D) paradigm. Central to this article is a critical review and synthesis of scholarly literature, including theoretical frameworks, empirical studies, and case analyses across the aforementioned fields. This process involves identifying and interrogating key concepts and debates relevant to the digital development (D4D) paradigm, particularly in relation to the challenges and opportunities presented by frontier technologies. The result is a nuanced understanding of D4D that acknowledges the complexity and (in)compatibility of integrating digital frontier technologies in development initiatives, while also spotlighting paths towards more equitable and sustainable technological futures.

Recognizing the hyperbole and the risks of the frontier technologies

First, let us clarify what is meant with frontier technologies. Frontier technologies refer to cutting-edge and advanced technological innovations that are at the forefront of scientific and technological progress. Frontier technologies are characterized by their novelty, complexity, and promise transformative capabilities. We can identify three overarching types of frontier technologies (see : World Intellectual Property Organization Fact-sheet https://www.wipo.int/about-ip/en/frontier_technologies/pdf/frontier-tech-6th-factsheet.pdf):

1. *Digital technologies* such as: The Metaverse, Augmented Reality (AR), Virtual Reality (VR), Blockchain, Artificial Intelligence (AI), Big Data, Quantum Computing, etc..
2. *Physical technologies* which includes: autonomous driving, 3D printing, hardware innovations such as robotics or 5G technology, and more.
3. And lastly, *biological technologies* such as: bioprinting, organoids, genetic engineering, human augmentation and the brain-computer-interface, etc..

Certainly, frontier technologies represent not the first instance of overselling and hyperbole for the development sector. However, the promises of frontier technology are significant (see: UN's "World Economic And Social Survey 2018: Frontier Technologies For Sustainable Development"; UNCTAD's "Technology and Innovation Report 2023"; World Economic Forum's "Fourth Industrial Revolution: Frontier Technologies"; among others).

The promises of frontier technologies, however, entail a profound paradox. It is perplexing how the ambitious promise of frontier technologies to bolster and hasten the achievement of the UN's 2030 Sustainable Development Agenda has not been fully realized, given the current global challenges. We have entered a turbulent era of 'polycrisis'. New wars, conflicts and military coups are emerging on almost every continent in the world with "a quarter of humanity is involved in 55 global conflicts around the world" (Türk 2023). The escalation and increase in natural disasters caused by climate change marked 2023 as the warmest year on record. The Covid19 pandemic led to a severe global recession, the effects of which are still being felt today, affecting especially the poorer social classes. We are witnessing the rise of far-right politics, which is increasingly taking control of governments in Europe and beyond, questioning the global architecture of international cooperation. Finally, Sustainable Development Goals (SDGs) are, for the first time, in peril. For the third year in a row, global progress on the Sustainable Development Goals (SDGs) has been static, and 'none of the goals will be achieved by 2030, and on average, less than 20% of the SDG targets are on track to be achieved' (SDG Report Press Release: 2023).

When it comes to emerging technologies, World Economic Forum's "The Global Risks Report 20233" warns that "[even] for countries that can afford it, these technologies will provide partial solutions to a range of emerging crises, from addressing new health threats and a crunch in healthcare capacity to scaling food security and climate mitigation. For those that cannot, inequality and divergence will grow. In all economies, these technologies also bring risks, from widening misinformation and disinformation to unmanageably rapid churn in both blue-and white-collar jobs". Inevitably, we should ask: now that the global development, cooperation and security order needs (frontier) technology to transform its 'polycrisis' predicament, how (frontier) technology is helping to tackle some of the world's most pressing issues and transform the lives of those most in need? While technology, I argue, holds transformative potential, there is a critical need to scrutinize whether its application effectively addresses the world's most pressing issues and truly transforms the lives of those in need. This skepticism is grounded in the observation that,

despite technological advancements, tangible improvements in global crises management remain yet elusive.

Frontier technologies, specifically its flagship technology-system known as 'Artificial Intelligence (AI)', represent the overselling hyperbole whose successes remain yet in the speculative realm while its harms are empirically proven (Couldry, Mejias 2019; Eubanks 2019; O'Neill 2016; McQuillan 2022; Benjamin 2019). The hyperbole of digital frontier technologies is manifested through three main operations: 1) futuring; 2) scaling; and 3) deterritorialization. We will see next how these are working towards re-shaping the D4D paradigm.

Futuring

Frontier technologies are primarily developed and shaped by the private sector, mainly by start-up companies and established tech firms. Since innovation is expensive and requires 'resources and financial investment' (Mazzucato 2018), companies offering frontier tech services secure funding through different investors: accelerators, angels, venture capital VC, private equity, family offices, government non-profit funds, and corporate investors (Komljenovic et al 2023). For instance, Microsoft owns 49% of OpenAI, one of today's leading AI companies[1]. As it is often the case, most investors provide financial support in search of return on investment (ROI). This is achieved by creating value in the future (Varoufakis 2017). Part of this process is the discursive construction of narratives aimed at creating and cultivating a gradual consensus among the general public and policymakers about the *future imaginaires*[2]. I call this process the *futuring of everyday life.* The act of futuring, within the social-theoretical scholarship can be defined as "the identification, creation and dissemination of images of the future shaping the possibility space for action, thus enacting relationships between past, present and future" (Oomen J.l, Hoffman J., and Hajer A. M. 2021).

Frontier technologies function as 'rhetorical weapons' to (re)construct the *futuring of everyday life*. The operation of 'futuring' paves the way and prepares the public–and institutions–for the

[1] As of November 20, 2023, Investor's Business Daily listed on their page: https://www.investors.com/news/technology/microsoft-stock-software-giant-hires-openai-executives/#:~:text=Microsoft%20owns%2049%25%20of%20OpenAI,Altman%20was%20leaving%20the%20company

[2] I rely here on the exemplary work of Janja Komlenovic, Ben Williamson, Rebecca Eynon and Huw C. Davies in unveiling the investors' future imaginaries in the education sector through their empirical examination of VC Edtech investors. *Komljenovic J., Williamson B., Eynon R., Davies. C. H. (2023) "When public policy 'fails' and venture capital 'saves' education: Edtech investors as economic and political actors".*

upcoming hyperbole. One frontier technology currently leading this hyperbole is AI. This is not coincidental, as one of the core tenets of AI technologies lies in the 'science of predictability'. AI emulates science by collecting data and making models, but the predictions of AI diverge from scientific process; they are not the expressions of hypothesis, a coherent theory about the way things work, but simply extrapolations from superficial patterns (McQuillan 2022). As McQuillan (2022) argues, "AI is not realist but instrumentalist: it only models the world to get something out of it", that is, a futuring of everyday life that relies on correlations, not causation. Futuring through 'prediction' is, therefore, risky territory for the development sector, particularly if this is shaped and led by the private firms alone. It leads to the financialization, marketization, commercialization, and assetization of the international development field, and to a certain degree, the nonprofit sector. This contributes to displacing the focus, resources, and efforts towards the tools for futuring rather than addressing the urgent human needs of the present.

Scale

Scaling has become central to both the current functioning and future envisioning of society. Frontier technologies are designed for transnational scaling. Pfotenhauer et al. (2022) observe that "in the era of big tech, the aim is frequently to scale up first and profit later. Silicon Valley financiers explicitly select new ventures for their (blitz-) scalability in all-or-nothing domination strategies". Scaling operationalizes in practice what the futuring of everyday life constructs through narratives.

The logic of scaling has permeated other fields, such as policymaking, public research, development, and nonprofit organizations. Policy initiatives and public research programs are increasingly justified in terms of addressing 'grand societal challenges,' as seen in the European Commission's upcoming Horizon Europe funding program and various initiatives related to the UN Sustainable Development Goals. These challenges call for scalable solutions, such as 'mission-driven innovation' that breaks socio-technical transformations into manageable and scalable segments (Mazzucato, 2018, as cited in Pfotenhauer et al., 2022). Discussions around 'social innovation,' traditionally more focused on bottom-up dynamics and local alternatives, are now also advocating for scaling up (Gabriel, 2014; Musa and Rodin, 2016; Westley et al., 2014, as cited in Pfotenhauer et al., 2022). The Principles for Digital Development[3] even include a specific principle

[3] For more please see Principles' page here: https://digitalprinciples.org/

named 'Design for Scale,' albeit with a more nuanced definition. Pfotenhauer et al. (2022) rightly argue that the concept of 'scale' has evolved beyond merely denoting geographic reach to become an actor-centered category. In this framework, ‘scale’ becomes an “imperative and framing device for businesses, governments and NGOs alike that prescribes what seems worth doing, what the rules of engagement are and how we define problems or solutions” (Pfotenhauer et al. 2022).

The allure of frontier technologies for investors, policymakers, and development actors is undeniable, offering rapid solutions – ‘technological fixes’ – to complex social challenges. However, the ‘politics of scaling’ often favors technical solutions which cut problems into narrow and discrete pieces that may be solved by the owners of ready-made scalable platform technologies (Pfotenhauer et al. 2022). One example of this is Amazon’s Mechanical Turk platform. This platform gave rise, in scales unforeseen before, to 'crowdwork': the practice of dividing large volumes of time-consuming tasks into smaller ones that can be quickly completed by millions of people worldwide. It was thanks to thousands of crowdworkers engaged through Mechanical Turk that paradigmatic dataset ImageNet, which was instrumental in advancing computer vision and deep learning research, achieved to label more than 14 million images, each of which is tagged, belonging to more than 20,000 categories. However, many of the frontier technologies that have reached high market shares are built and maintained by thousands of ‘ghost workers’ in the Majority World who are underpaid, sometimes as little as few cents, with no agency/subjectivity given that they work under complete conditions of anonymity, and with “little institutional, regulatory oversight” (Heeks, 2017).

This exploration into ‘scalability’ encourages deeper reflections on the D4D paradigm questioning the power dynamics within the 'politics of scaling', who determines the scaling agenda—both technologically and geographically—and how the 'scale-or-die' ethos of private tech firms impacts efforts like climate change. Above all, echoing Gayatri Ch. Spivak, we should ask: can the Subaltern scale?

Scaling as promoted today constructs a reality that is monocultural, centering the West as a single reality. Consequently, devoiding subalternity from their desires, aspirations, *their* vision of futuring, and the sense of identity and belonging. Moreover, current scaling practices reinforce existing power dynamics of subjugation between the Center and the Periphery, neglecting the

world of many centers. Scaling, as understood and practiced today, leads thus to processes of deterritorialization and reterritorialization, further entrenching these disparities.

Deterritorialization and reterritorialization

Through futuring and scaling, frontier technologies significantly contribute to the operational dynamics of deterritorialization and reterritorialization. This process unfolds gradually, beginning with the construction of a new type of reality that aligns with the narratives of technology firms and investors. Subsequently, it involves developing and expanding technologies aimed at addressing the world's most critical problems, through 'deterritorialization and reterritorialization of development sectors'.

The interplay between futuring and scaling within the D4D paradigm underscores a transformative process, where established territories of development are dismantled (deterritorialized) and new configurations and structures are established (reterritorialization). This operation has the functioning of displacement. Frontier technologies, acting as main actors in this paradigm, contribute significantly to shaping the contours of this displacement, influencing not only the geographical and socio-political landscapes but also the conceptual frameworks that define development. In essence, they become pivotal agents in the ongoing process of deterritorialization and reterritorialization within the realm of D4D.

For instance, education is one of the most established 'territories' of development. Historically, investors were hesitant to invest in the education sector due to low returns, long investment cycles, fragmented markets, heavy regulation, and public hesitancy towards privatization (Komljenovic et al. 2023). However, over the past decade, we can observe a steady exposure of the education sector to the processes of deterritorialization and reterritorialization. This trend accelerated and reached its peak during the Covid-19 pandemic. The number of educational technology (Edtech) 'unicorns', companies valued at more than $1 billion, increased from 0 in 2014 to 62 in 2021 (Brighteye Ventures 2022, as cited in Komljenovic et al. 2023), and venture capital investment in Edtech rose from $500 million in 2010 to more than $20 billion in 2021 (Komljenovic et al. 2023). The process of deterritorialization and reterritorialization of the education field can be observed in an analytical essay by Williamson et al. (2022) titled *"Amazon and the new global connective*

architectures of education governance". The authors identify five interlocking governance operations and their effects:

- *inscribing* commercial business models on the education sector;
- *habituating* educational users to Amazon technologies;
- *creating new interfaces* with educational institutions;
- *platforming* third party education providers on the cloud;
- *re-infrastructuring*, involves migrating an educational institution's digital infrastructure to a private tech firm's infrastructure, such as Amazon Web Service, thereby transferring provision and control of key information infrastructures of education.

The first four of Amazon's governance operations ('inscribing,' 'habituating,' 'interfacing,' and 'platforming') can be viewed as the process towards deterritorialization of public education. Meanwhile, the fifth governance operation ('re-infrastructuring') represents the attempt at reterritorialization where the old reality is displaced by the newly constructed one.

These forms of deterritorialization and reterritorialization will be increasingly more present and further accelerated in international development. One frontier technology that will amplify, accelerate and intensify further this process is AI. Other sectors, such as health, agriculture, environment, etc., may be even more exposed to the process of deterritorialization and reterritorialization by AI-driven technologies and automations.

We have examined how the hyperbole of frontier technologies is constructed, operates, shapes and impacts the D4D paradigm. These technologies, characterized by their cutting-edge nature across digital, physical, and biological spheres, promise transformative capabilities but also introduce a paradox. Despite their potential to support the UN's 2030 Sustainable Development Agenda, the realization of these promises remains limited amidst existing polycrisis and lack of progress of SDGs in the last three years. The operations of futuring, scaling, and deterritorialization underscore a complex interplay that reshapes the landscape of development. These operations are largely ideological in nature. We will try, in the next section, to examine ideological nature of D4D paradigm and its intersection with frontier technologies.

Understanding ideological nature of frontier technologies and its intersection with D4D paradigm through 'Techfluence Model'

'Technology is not neutral', states the first principle of the late-1990s Technorealism Manifesto (Bennahum et al. 1998), written collaboratively by twelve technology writers. But in what sense

technology is not neutral? Technology as such is designed by humans, is deployed and used by humans, is adopted and re-appropriated by humans in different contexts around the world—its complexity is, therefore, inherently shaped by human perspectives, values, beliefs, motivations, and experiences (Salaj 2023). The built-in design of technology not only guides but also influences how it will be used. For example, a microphone is designed and crafted for amplifying speech. One cannot use the microphone as a screwdriver. Yet, with exceptional 'hacking capabilities,' one might repurpose its design for unintended uses. Thus, *technology is not neutral, but neither is it deterministic*. This is where we can lean on the concept of technology affordances, introduced by Hutchby (2011), as a non-deterministic perspective that acknowledges the unique material characteristics of technologies while allowing for diverse interpretations and uses. Hutchby uses the example of a bridge which can be presented in at least two competing ways: as a means of carrying people over a road or as an instrument for the perpetuation of racial inequality. Inherently, technologies carry both intentional and unintentional biases that mold our social, political, and economic views, influencing our worldview and interactions significantly.

At this juncture, introducing the "Technology Design and Influence Model Analysis" (briefly, "Techfluence") becomes crucial, enabling an examination of how the design and application of technology mirror the motivations, socio-political contexts, and ideological leanings of those in control.

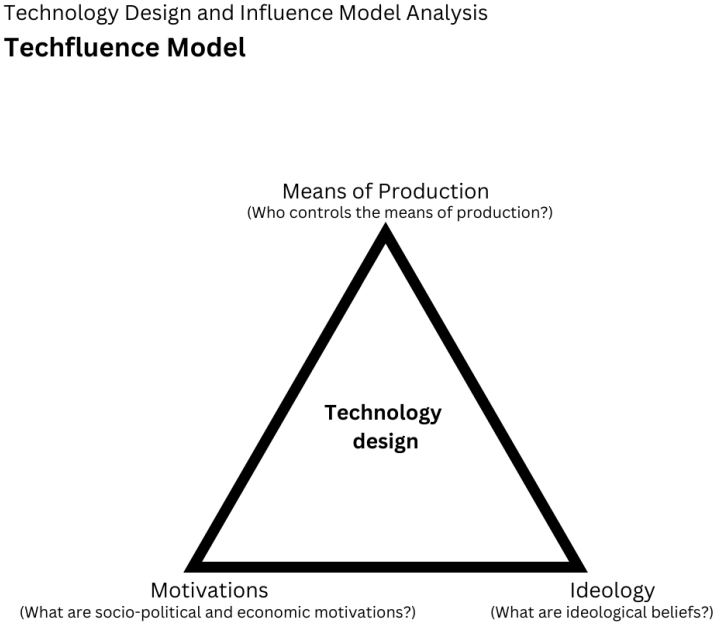

Figure 1 - Technology Design and Influence Model Analysis

The design of technology is significantly influenced by three key elements: 1) the means of production, specifically, who controls them; 2) the underlying motivations, particularly socio-political and economic motivations; and 3) the ideological beliefs driving its development. These elements collectively play a crucial role in shaping how technology is designed, promoted, deployed, and utilized. To illustrate this argument, two historical examples provide insightful context.

The first example takes place before and during World War II. Nazi Germany maintained a long-lasting business relationship with the U.S.-based multinational, International Business Machines (IBM), to develop punched card technologies. These technologies helped the Nazi regime organize its national census, provide a quantified portrait of the nation and its citizens, and identify Jews, Roma, and other ethnic groups deemed undesirable. They were later used during concentration camps to statistically measure their capacity. And this was how "human progress" was defined by the Nazi Regime in Germany.

On the other hand, other motivations and ideological beliefs were shaping Chile's Project Cybersyn between 1971-1973. Project Cybersyn was launched during the presidency of Salvador Allende aimed at constructing a distributed decision support system to aid in the management of the national economy. The project consisted of four modules: an economic simulator, custom software to check factory performance, an operations room, and a national network of telex machines that were linked to one mainframe computer. Project Cybersyn was based on a viable system model theory approach to organizational design, and featured innovative technology at its time: it included a network of telex machines ('Cybernet') in state-run enterprises that would transmit and receive information with the government in Santiago. The project, after the military coup on 11 September 1973, was abandoned, and the operations room was destroyed. In a 2014 essay for The New Yorker, technology journalist Evgeny Morozov argued that Cybersyn helped pave the way for big data and anticipated how Big Tech would operate, referring to Uber's use of data and algorithms to monitor supply and demand for their services in real time as an example.

Table 1 - Techfluence applied two Punch Card technology and Project Cybersyn

Elements/Aspects	**IBM-Nazi collaboration during World War II**	**Project Cybersyn in Chile**

1. Means of Production	Private corporation (IBM)	State (Chilean government under Salvador Allende)
2. Motivations	Profit generation; Facilitating Nazi regime's objectives	Economic growth and efficient national economy management; Supporting socialist policies.
3. Ideology	Technology used in alignment with extreme right ideology	Left (Socialist principles for collective management and decision-making)

Although the two examples mentioned above belong to the pre-digital paradigm, it is worthwhile to examine digital frontier technologies and apply the model analysis to more contemporary instances. Exploring two additional cases, I believe, will further enrich our analysis.

In a research paper "Gender shades: intersectional accuracy disparities in commercial gender classification" (Buolamwini and Gebru 2018), the authors uncovered large gender and racial bias in AI systems sold by tech giants like IBM, Microsoft and Amazon. Given the task of guessing the gender of a face, all companies performed substantially better on male faces than female faces. The companies that the authors evaluated had error rates of no more than 1% for lighter-skinned men. For darker-skinned women, the errors soared to 35%. AI systems from leading companies have failed to correctly classify the faces of Oprah Winfrey, Michelle Obama and Serena Williams.

Another, even more recent, study "Large language models propagate race-based medicine" (Omiye et al. 2023) evaluated four large language models (Bard, ChatGPT, Claude, GPT-4), which are trained using using backpropagation as part of the broader training process, with nine different questions that were interrogated five times each with a total of 45 responses per model. According to the study, "all models had examples of perpetuating race-based medicine in their responses [and] models were not always consistent in their responses when asked the same question repeatedly." All of the models tested, including those from OpenAI, Anthropic, and Google, showed obsolete racial stereotypes in medicine. GPT-4, for example, claimed that the normal value of lung function for black people is 10-15% lower than that of white people, which is false, reflecting the (mis)use of race-based medicine.

There is a clear pattern from the findings of both studies, that is: despite advancements in AI technologies and the passage of five years, the power relationships, stereotypes, prejudices, and

biases remain deeply embedded in AI systems designed by the private sector. Both examples illustrate how AI, across different applications—from facial recognition to large language models—continues to reflect and perpetuate societal inequalities. This persistence of biases in AI, regardless of the technology type or application, underscores a pattern within the tech industry's approach to AI development. The private sector's control over AI production and the lack of diversity among those who design these systems result in technologies that fail to accurately represent or serve all segments of society.

Table 2 - Techfluence applied to two distinct researches on AI technologies

Aspect	Gender Shades (2018)	Race-based Medicine in Language Models (2023)
1. Means of Production	Private (IBM, Microsoft, Amazon)	Private (OpenAI, Anthropic, Google)
2. Motivations	Profit generation; Market leadership (and monopoly) in the field of facial recognition technology,	Profit generation; Market dominance in the field of Generative AI.
3. Ideology	Neoliberal; libertarian. With a strong focus on market solutions and innovation.	Neoliberal; libertarian; technocratic. Prioritizing technological advancement and efficiency.

The intersection of technology, ideology, and political movements is not a new phenomenon. More recently, with the rise of Web 3.0—characterized by decentralized networks, blockchain technologies, semantic web, artificial intelligence, and enhanced personalization and security—the connection between technology and ideology has deepened significantly. For instance, Bitcoin, blockchain-based decentralized cryptocurrency, touted by many as alternative currency, harbors a strong ideological appeal: “it often embodies profoundly ideological and overtly conspiratorial anti-Central Bank rhetoric propagated by the extremist Right in the US” (Gombia 2015). Similarly, the association of AI with eugenics and the neoreactionary movement "Dark Enlightenment" is

extensively documented in recent scholarship (McQuillan 2022, Arcas et al. 2017, Pasquinelli 2023, Panofsky 2015, and Williamson et al. 2023). “Freedom and democracy are not compatible”, wrote (in)famously Peter Thiel (Thiel 2009), a notable proponent of libertarianism, co-founder of Paypal, Palantir Technologies, and Founders Fund venture capital. His ventures, including Palantir's involvement in Cambridge Analytica's efforts to influence the 2016 U.S. elections and its links to controversial startups like Clearview—whose connections with the USA’s alt-right movement have been well documented (O’Brien 2020)—highlight the potential social harms of these technologies. This is particularly concerning when such technologies are adopted by government law enforcement or international development agencies under the guise of Digital Development. In February 2019, a $45 million partnership between the United Nations World Food Programme (WFP) and Palantir Technologies raised concerns about data privacy and the ethical implications of such collaborations, highlighting the need for transparency and accountability. Palantir Technologies is the US software firm known for its association with CIA and Cambridge Analytica and its work on predictive policing, advanced biometrics, and immigration enforcement (Madianou 2019: 1). The signing of this deal raised many concerns about whether Palantir will have access to the sensitive data or metadata of the 91.4 million people served by WFP each year, prompting 65 civil society organizations and individuals to write a letter to David Beasley, WFP’s executive director, asking for “concrete steps to mitigate the serious harm arising from the agreement” and full transparency which is essential for meaningful accountability (Madianou 2019: 1). As we move into the era of Generative AI, which promises high efficiency with minimal resources, the question arises: should international development depend on the private sector, especially when its agenda—Sustainable Agenda 2030—is identified as *enemy* to the private sector's drive for techno-acceleration agenda, as articulated in Marc Andreessen’s recent "Techno-Optimist Manifesto"[4]?

The exploration of technology's ideological nature in this section reveals the profound influence of control, motivations, and beliefs on technology's design and deployment, underscoring the non-

[4] Marc Andreessen is Cofounder and General Partner at the venture capital firm Andreessen Horowitz whose a16z portfolio has $35B in assets under management across multiple funds. In his recent Techno-Optimist Manifesto, he writes: “Our present society has been subjected to a mass demoralization campaign for six decades – against technology and against life – under varying names like “existential risk”, “sustainability”, “ESG”, “Sustainable Development Goals”, “social responsibility”, “stakeholder capitalism”, “Precautionary Principle”, “trust and safety”, “tech ethics”, “risk management”, “de-growth”, “the limits of growth”.” Accessed on 23 February 2024: https://a16z.com/the-techno-optimist-manifesto/

neutrality of technology. This complex interplay demands a critical examination of technology's role in society, especially as we confront the challenges posed by digital frontier technologies. Moving forward, we will delve into the (in)compatibility of these technologies within the D4D framework, examining them through the framework of Principles for Digital Development.

Acknowledging the (in)compatibility of the frontier technologies with D4D paradigm

This section will explore the (in)compatibility of frontier technologies with the D4D paradigm. We will do this by taking the Principles for Digital Development as an organizing framework (see: www.digitalprinciples.org/).

The Principles for Digital Development known shortly as 'Digital Principles' are a set of nine guidelines for integrating best practices into technology-enabled development programs for international development and cooperation. They were initiated in 2009 when UNICEF launched their Principles for Innovation and Technology Development. Over 200 organizations worldwide endorsed the new Principles for Digital Development, recognising them as a tool for helping organizations to facilitate and deploy ethically-driven ICT initiatives. Created in a community-driven effort, and as the result of many lessons learned through the use of information and communication technologies (ICTs) in development projects, the principles include guidance for every phase of the project life cycle.

Digital Principles emerged during the ICT4D 2.0 paradigm, marking a time when the development community's interest in Web 2.0 technologies—known for user-generated content, user-friendly interfaces, and a participatory culture—significantly increased. While digital technologies offer significant (potential) benefits, enhancing global communication and connection at unprecedented speeds and scales, thus acting as enablers for vital human values and activities—the critical research technology studies highlight the adverse societal impacts of these technologies, which affect many worldwide and lack effective management, control, or governance.

Given the widespread endorsement of Digital Principles by the international development community and their central role in guiding ethical and responsible technology use, we will use this framework to examine the (in)compatibility of a *small set of selected digital frontier technologies* by analyzing a few examples from recent literature.

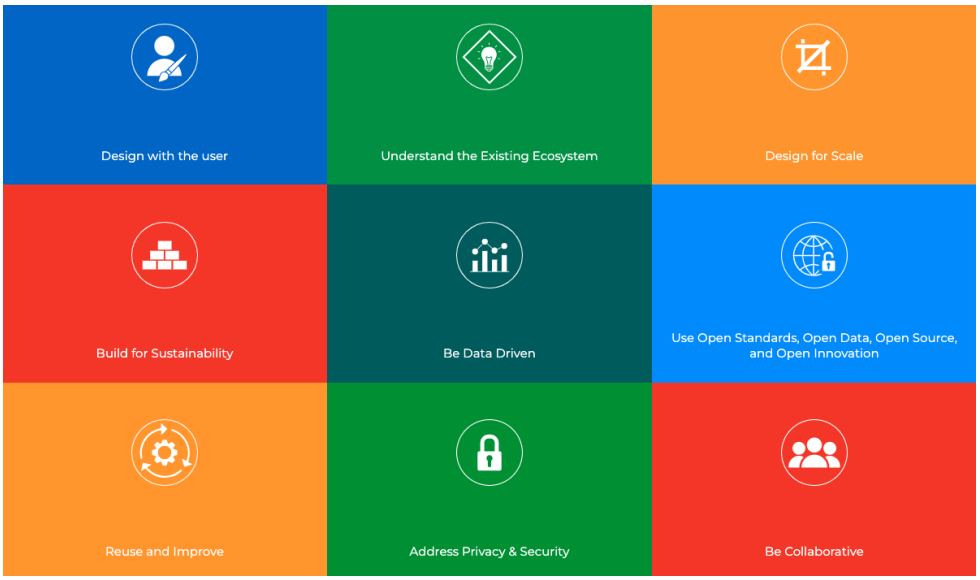

Figure 2 - Principles for Digital Development

- *AI technology:* AI's reliance on extensive (personal) data for algorithm training may conflict with the principle of "Address Privacy and Security," risking infringement upon individual privacy rights. The proprietary nature of AI algorithms may also conflict with the commitment to "Use Open Standards, Open Source, and Open Innovation," potentially hindering transparency and collaborative progress. Furthermore, the often opaque decision-making processes in AI could be at odds with "Building for Sustainability," due to challenges in ensuring transparency and accountability—essential aspects of trust and long-term sustainability in digital development. While AI technologies may hold the potential to significantly "Design for Scale," catering to a wide user base rapidly and effectively—this scalability carries a great risk. If AI is designed with biased data, the scale at which it can perpetuate harm is substantially amplified, spreading biased decisions quickly across vast networks and user groups. have become increasingly common in humanitarian contexts over the years. For instance, the Silicon Valley start-up X2AI launched 'Karim', a psychotherapy chatbot, to support Syrian refugees in Lebanon. Madianou (2021) highlights several concerns associated with chatbot deployment, including risks related to data security and the spread of misinformation. Furthermore, by reducing participation to mere 'box-ticking exercises' and leveraging data for experimentation without meaningful consent, argues Madianou, these technologies extract

value from data and experimentation with new technologies and by asserting Eurocentric values in humanitarian contexts chatbots reproduce the asymmetries between affected people and humanitarian organizations.

- *Blockchain technology:* The application of blockchain technology presents several challenges when evaluated against the Digital Principles. “Design for Scale” principle becomes incompatible, especially in under-resourced environments where the digital infrastructure may not support the extensive demands of blockchain networks. In terms of sustainability, the high energy consumption associated with blockchain, particularly proof-of-work systems, not only directly challenges the Sustainable Development Goals by significantly increasing carbon footprints, but also potentially minimizes the long-term sustainability of the project or programme (principle “Built for Sustainability"), particularly in low-resourced environments. “Address Privacy and Security” and “Be Collaborative” principles are also at stake. The technology's replicable and public nature prompts concerns about privacy and data protection, especially when blockchain-enabled cash transfers employ biometric verification reliant on algorithms. Furthermore, blockchain's immutability—no single user can control the whole network, and at the same time, information cannot be deleted, new blocks can only be added—which in other contexts may be a desirable feature, can have disastrous consequences in volatile situations if records are erroneous (Madianou 2019), posing an a significant challenge with the principle of collaborativeness. This characteristic, while advantageous in stable contexts, complicates collaboration, privacy and security in humanitarian or crisis environments, where the need to update or correct information is critical.
- *Metaverse, VR, and AR technologies:* while innovative, these technologies present unique challenges to the Digital Principles. These technologies can intensify digital divides, raise privacy and ethical concerns, and demand high computational resources, potentially conflicting with sustainability goals. For instance, VR headsets can collect more and richer data about users compared to traditional screens; simultaneously, malicious users can monitor and collect metaverse users' behavior (e.g., interaction with other users, purchase actions) and biometrics (e.g., facial expressions, vocal inflections) in real-time, which could be used to recognize the user (Dwivedi et al. 2023). Moreover, metaverse systems may also cause physical harms. Researchers found that by exploiting and hacking VR

systems, it is possible to control the activities of immersed users and physically move them to a location without their knowledge (Casey et al., 2021, as cited in Dwivedi et al. 2021). For instance, by manipulating a VR platform and resetting the hardware's physical boundaries, an adversary can influence a user to take actions that make them *f*all down a *flight of stairs* and cause serious *injuries* (Dwivedi et al. 2023). In addition to VR, security breaches associated with AR can have even more serious consequences. As Dwivedi ed al. (2021) highlights, users could potentially be misdirected into a street, which can lead to a dangerous physical situation such as robbery, mugging, assault and even trafficking (Nichols 2022).

This brief exploration of a selected set of digital frontier technologies through the lens of the Principles for Digital Development reveals a challenging landscape, identifying various incompatibilities between the selected technologies and the principles. AI technology, with its reliance on extensive personal data, large and expensive computing infrastructure and opaque decision-making processes, challenges the principles of privacy, security, openness, and sustainability. The implementation of blockchain technology, while innovative, faces significant hurdles in scalability, energy consumption, security, and collaboration, particularly in under-resourced and low-rights environments and humanitarian contexts. Similarly, the advent of Metaverse, VR, and AR technologies introduces new dimensions of privacy, ethical concerns, and sustainability challenges, with risks of intensifying digital divides and potentially causing physical harm. While digital scientists, technologists, development, and humanitarian actors bear a significant societal responsibility in addressing these challenges, there is also a need to update, and perhaps expand, the framework of the Digital Principles to adequately respond to the latest technological advancements.

Conclusions

We are living in a predicament deadlock marked by a profound global crisis, encapsulated in what Ziauddin Sardar (2010) termed 'postnormal times.' All that was 'normal' has now evaporated; we have entered postnormal times, the in-between period where old orthodoxies are dying, new ones have not yet emerged, and nothing really makes sense (Sardar 2010). This period of transition, argues Sardar, is marked by three c's: complexity, chaos and contradictions. Consequently, 'these forces propel and sustain postnormal times leading to uncertainty and different types of ignorance that make decision-making problematic and increase risks to individuals, society and the planet'

(Sardar 2010).

The current polycrisis is the symptom of a deeper crisis of commons, spanning to peace, environmental degradation, biogenetics and other frontier technologies, digital governance, financial instability, new forms of segregation, challenges in managing crises, debates over intellectual property, and the erosion of (personal/collective) freedoms. Yet, most of these crises are in a stalemate. Wars drag on or morph into intractable conflicts without clear resolutions, climate change accelerates unabated without a unified global strategy, and the governance of new technologies remains contested, caught between market and social values. Notably, in a period where global cooperation is paramount, we witness a re-emergence of Cold War-era divisions and polarizations between Western and Eastern blocs, with Non-Aligned countries navigating the spaces in between.

The tensions, dilemmas and cautionary notes outlined in this article regarding the D4D paradigm do not occur in vacuum. They are deeply intertwined with the broader crisis landscape we have described. Therefore, a pertinent question arises: amid the current global complexity, chaos, and contradictions, how can the D4D paradigm effectively reorient itself to serve humanity at large—especially those most in need? One response to this crisis is in ways and extends in which we are able to reimagine and regenerate the commons. This action of 'commoning' is inherently tied to the principles of democracy and human rights, providing a framework for an equitable and sustainable D4D paradigm.

Consider, for instance, how Big Tech companies—Alphabet (Google), Amazon, Meta (Facebook), Apple, and Microsoft, along with China's own Big Tech giants such as Baidu, Alibaba, Tencent, and Xiaomi (BATX)—have significantly monopolized the technological landscape. This monopolization, concentrating immense power within a few entities, undermines two fundamental principles of (liberal) democracy: 1) *Power distribution*, which is intended to facilitate dialogue and establish a consensus among varied actors, free from polarization; 2) *Equality*, which takes the form of proportionality, that is, equality in diversity or among the diverse (Sartori 2023). The laws apply equally to all ('equal treatment'), argues Giovanni Sartori, while direct taxation should be proportional ('to each equal the same'), in proportion to one's richness. Therefore, the proposition 'equal for equal but unequal for unequal' as argued by Sartori (2023) suggests that the same outcome means to disadvantage the favorites and favor the disadvantaged. Additionally, as commons such as water, education, genetic heritage or culture are increasingly privatized in the

name of financial state of exception (Caperchi 2012), the relationality of the community to the commons needs to be reasserted (Mattei, 2011, cited in Caperchi 2012). This process involves the support, facilitation, and integration of decentralized and alternative community solidarity initiatives, which are emblematic of social and economic micro-democracies, as defined by Sartori (2023).

Such spaces can manifest as light, open communities— a concept defined by Ezio Manzini (2019). These communities are characterized by their small size, hyper-localized focus, and collaborative nature, uniting individuals to address specific challenges within the realms of sustainable design and community-based solutions (Manzini 2019). In these groups, the individuality of each member is harmoniously balanced with a collective desire to achieve a common goal.

A reorientation of D4D paradigm words regeneration of commons means also moving away from the imperatives of acceleration and scale-up towards embracing horizontal and scaling-down, fostering genuine interaction and action at the (hyper)local level. This involves proposing 'alternative ways of knowing [and collaborating], rooted in the lived experience of people who are marginalized or minoritized' (McQuillan 2022). One proposal for how to do this comes from Post-Normal Science which proposes ‘Extended Peer Communities’ (EPC). P-normal science was proposed in 1990 by Silvio Funtowicz and Jerry Ravetz as a way of positioning science within the wider matrix of social factors, especially when acts are uncertain, values in dispute, stakes high, and decisions urgent’ (Ravetz, Funtowicz 2003). Extended Peer Communities (EPC) represent a democratic approach to policy-making, governance, and scientific legitimacy: in post-normal science, the manifold uncertainties in both products and processes require that the relative importance of persons becomes enhanced. Hence the establishment of the legitimacy and competence of participants will inevitably involve broader societal and cultural institutions and movements (Funtowicz and Ravetz 1993). Through a variety of participatory mechanisms (e.g. neighborhood councils, public hearings and assemblies, focus groups, etc.), EPCs actively involve community members not just as recipients but as contributors of knowledge, from anecdotal evidence to investigative findings. This framework encourages the extension of government accountability to the governance of science and technology, promoting a shift from rigid scientific demonstrations to inclusive dialogues. EPCs foster policy formation, implementation, and monitoring through collective, interepistemic conversations and actions, thereby paving the way for concepts like Post Normal AI (McQuillan 2023), which seeks to integrate immersive

relationality into AI technology governance.

While light, open communities are configured in project-centered distributed micro-democracies, simultaneously enabling EPCs to engage in alternative knowledge production for policy-making and governance—it's also important to revisit the work of philosopher and social critic Ivan Illich when discussing technology. For Ilich, a vital part of producing convivial technology was the idea of *negative design criteria* to define the limits within which tools are kept. He anticipated the potential of large-scale harm and threats of contemporary technologies: ‘there are two ranges in the growth of tools: the range within which machines are used to extend human capability and the range in which they are used to contract, eliminate, or replace human functions’ (Ilich 1973). Ilich’s negative design criteria is inherent also within democratic and human rights frameworks. For instance, as discussed above, the importance of limiting power thresholds and distributing it to prevent any single entity from becoming so dominant that it undermines the democratic fabric itself. Similarly, in the context of human rights, Illich's perspective aligns with the idea that rights such as freedom of expression have boundaries; when exceeded, these rights can harm society. For instance, freedom of expression is protected, but ‘given that it comes with duties and responsibilities’ it is also subject to limitations when it incites violence or spreads hate speech. illustrating a 'negative criteria' where certain limitations are necessary for the greater good of society.

In contrast to Ivan Illich's negative design criteria, contemporary frontier technologies in general, and AI technologies specifically, are driven by an ethos of indefinite growth and expansion. AI technologies, for instance, are designed to continuously grow their models, requiring infinite amounts of data for training, its application is spanning across vast numbers of domains, consequently ‘contracting, eliminating, or replacing human functions’. More largely, the limitless expansion and application of AI technologies reflect and aligns with the capitalist imperative of infinite accumulation and growth.

As the D4D paradigm seeks to navigate these challenges and reorient itself in the face of global complexity, chaos, and contradictions, the integration of democratic and human rights principles becomes crucial. The D4D paradigm should replace the language of market shares, equity funds and venture capitals, with that of solidarity, equality, and commons. Its agenda should serve towards the creation of social utilities, social economies, and civic/convivial technologies rather than integration and consolidation of Big Tech monopolies. The extent to which the D4D paradigm

can effectively serve humanity, particularly those most in need, will largely depend on how deeply democratic and human rights principles are embedded within its framework and operation. This necessitates a post-normal critical examination of technology choices, prioritizing those that align with Illich's vision of conviviality, that is: a convivial society should be designed to allow all its members the most autonomous action by means of tools least controlled by others (Ilich [1973], 1975).

If the final outcome of frontier technologies deployment in the real world is greater injustice, inequality, and marginalization, on one side, versus 'more efficiency, growth and acceleration with less resources', on the other, the differences between the two sides—injustice, inequality, marginalization vs. more efficiency, growth and acceleration with less resources—shall be calculated as democratic and human rights deficiencies, and the most vulnerable people shall pay the highest price.

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