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Another Scalability is Possible! From Nonscalability to Cosmolocal Scalability

Vasilis Kostakis* **, Lucas Lemos*, Asimina Kouvara*

*Tallinn University of Technology, Tallinn, Estonia, vasileios.kostakis@taltech.ee, lucas.barreiro@taltech.ee, asimina.kouvara@taltech.ee
**Berkman Klein Center for Internet and Society, Harvard University, Cambridge, USA, vkostakis@cyber.harvard.edu

Abstract: This article addresses Anna Tsing's critique of capitalist scalability by introducing the concept of "cosmolocal scalability" as an alternative to approaches that prioritise "scale-at-all-costs." Cosmolocal scalability challenges the idea of homogeneous, frictionless expansion and instead proposes a context-responsive framework that values biodiversity, as well as the diverse ways of knowing and living. This framework enables local communities of practice to connect globally, fostering collaborative networks. Such connections are facilitated through digital tools and infrastructures that encourage the open exchange of knowledge, skills, and best practices as digital commons. By creating dynamic relationships between different scales – blending global connectivity with localised practices – cosmolocal initiatives nurture an ecosystem of adaptable, decentralised projects that aim to "scale wide" rather than "scale up." While several challenges still need to be addressed, cosmolocal scalability presents a promising pathway for fostering new social relationships and modes of production, ultimately laying the groundwork for post-capitalist futures.

Keywords: scalability, cosmolocalism, counter-hegemony, mid-tech, infrastructure

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1. Nonscalability

Anna Tsing's theory of nonscalability serves as a powerful critique of capitalist ideas about progress and growth, shedding light on the consequences of scalability. In her seminal article "On Nonscalability" (2012), Tsing argues that the modern world has been shaped by scalability projects – initiatives aimed at expanding and replicating supposedly successful models without making necessary transformations. These projects, which range from plantation agriculture to industrial manufacturing, rely on standardisation and often lead to the erasure of diversity.

Tsing emphasises the importance of "meaningful" biological and cultural diversity, which can inhibit scalability by requiring projects to adapt to different contexts. In contrast, scalability projects strive to create controllable and frictionless environments for expansion, reducing the intricate complexity of our world to what Tsing calls "nonsoels" – nonsocial landscape elements treated as interchangeable units. Nonsoels are intentionally stripped of their social and ecological connections, designed to function as uni-

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form, self-contained components within a scalable system. Examples of nonsoels include sugarcane clones on plantations, standardised labor units in factories, and even pixels in digital images. By creating these artificial and isolated units, scalability projects aim to eliminate the complexity of real-world interactions.

However, Tsing argues that this process of creating nonsoels is never truly complete, often overlooking or suppressing diversity and relationships that resist such simplification. Such scalability, she posits, is ultimately a seductive fantasy. In all its glorious messiness, diversity, and unpredictability, the real world resists frictionless scaling. Nonscalable elements – ecological, social, or economic – invariably disrupt attempts at seamless expansion. As Tsing puts it, "scalability is not an ordinary feature of nature. Making projects scalable takes a lot of work" (Tsing 2012, 505). This work, she reveals, often involves violence, exploitation, and the erasure of local complexities, painting a stark picture of the true cost of our relentless pursuit of growth.

Tsing's insights provide a compelling explanation for why capitalist scale-at-all-costs models are fundamentally unsustainable (Pfotenhauer et al. 2022). The fixation on scalability damages ecosystems, creates precarity, and is incompatible with the heterogeneous, interdependent nature of life on Earth. Adaptations in living systems proliferate not through deliberate promotion, but because they enhance the survival and well-being of species and their communities. When these adaptations lose their usefulness and become maladaptive, they either fade away or are discarded (Loring 2023). Tsing illustrates this through various examples, including the contrast between sugarcane plantations (an icon of scalability) and matsutake mushrooms (which resist scalable production). She argues for a nonscalability theory that accounts for the complex, transformative relationships scalability projects often ignore or suppress.

Tsing's work also challenges us to rethink our approach to knowledge itself. She points out that much of modern science demands scalability in its research frameworks, potentially obscuring the diversity pertaining to different ways of knowing and living. What seems scalable for scientific, technical, or economic reasons can differ greatly across regions, cultures, and legal boundaries (Pfotenhauer et al. 2022). By recognising the limitations and costs of scalability, we can develop more nuanced, context-sensitive approaches to understanding and interacting with our world.

Yet, as we stand on the precipice of mounting ecological and social crises, a question lingers: Could we reimagine scalability in more sustainable and inclusive ways? Is it possible to spread and replicate positive models without falling into the traps of capitalist scalability projects? This essay argues that an alternative form of scalability is indeed possible and already emerging – a concept we might call "cosmolocal scalability", offering a glimmer of hope in an increasingly complex world.

2. Cosmolocal Scalability

Cosmolocal production offers a novel trajectory of scaling that diverges significantly from traditional capitalist models (Kostakis, Niaros and Giotitsas 2023). This approach emphasises diversity, local adaptation, and open knowledge sharing, contrasting with the rigid standardisation and control typical of conventional scaling methods. The concept of cosmolocal production has emerged alongside the proliferation of digital communication networks (Schismenos, Niaros and Lemos 2020). It describes methods of connecting local communities through networks of shared resources and knowledge, effectively redefining community in terms of place. This is achieved via infrastructures that facilitate sharing knowledge, techniques, and practices over open communication channels.

In practical terms, cosmolocalism enables the localisation of collaborative forms of production while sharing resources globally as digital commons. Several technology initiatives exemplify cosmolocal practices. These include Wind Empowerment (https://windempowerment.org/), developing open-source small-scale wind turbines; OpenBionics (https://openbionics.org/), creating open-source robotic and prosthetic devices; LibreSpace (https://libre.space/), building open-source nanosatellites and other space research equipment; RepRap (https://reprap.org/wiki/RepRap), which focuses on open-source 3D printers; and agricultural projects like L'Atelier Paysan (https://www.latelierpaysan.org/) and Farm Hack (https://farmhack.org/), which develop open-source tools for small-scale farming.

The collaboration and interconnection among initiatives like L'Atelier Paysan from France, Farm Hack from the USA, and Tzoumakers (https://www.tzoumakers.gr/) from Greece, along with other open-source agriculture projects, exemplify this new mode of cosmolocal scalability. Farm Hack's and L'Atelier Paysan's online platforms allow farmers to freely share tool designs and modifications, which other farmers then adapt to suit their specific contexts. These initiatives also facilitate workshops where farmers collaboratively prototype new tools, with designs then shared openly for others to build upon. This approach enables a form of distributed experimentation and innovation. Tzoumakers, a community-driven rural makerspace in mountainous Northwestern Greece (Epirus) in which two of the authors participate, demonstrates this dynamic in action. By connecting with initiatives like Farm Hack and L'Atelier Paysan, the Tzoumakers community accesses a wealth of open-source designs and practices. Rather than simply replicating these, the initiative adapts them to meet the unique needs of local small-scale farmers and other stakeholders while considering regional resources. The tools and methods developed are then fed back into the global commons, enriching the collective knowledge base.

This multidirectional flow of ideas and designs, facilitated by digital platforms but realised through local manufacturing and experimentation, enables these initiatives to "scale wide" or "scale out" rather than "scale up". Besides, upscaling can lead to small initiatives losing their innovation potential (Druijff and Kaika 2021). These cosmolocal initiatives cultivate ecosystems of small-scale, locally-focused communities that are globally connected, nurturing the communal capabilities of individuals and groups, and contributing to the global digital commons. This approach embodies what Ezio Manzini (2015) calls "cosmopolitan localism" (or cosmolocalism), where local systems remain small and comprehensible to individuals and communities, yet are open to global flows of knowledge.

By leveraging the power of networks, these small-scale initiatives can operate effectively in complex, rapidly changing environments, fostering resilience and adaptability. Moreover, this scaling model promotes a new kind of production system where the global becomes a network of locals, as Manzini notes, enabling a harmonious balance between local autonomy and global interconnectedness.

What spreads through this network is not only technical knowledge, but also cultural practices and values. The ethos of open collaboration, autonomy, and ecological stewardship propagates alongside tool designs and manufacturing techniques. These values take root in new locales, creating fertile ground for other cosmolocal initiatives to emerge. This way of scaling represents a profound departure from capitalist scalability, which often erases local cultural practices in favour of homogenisation and profit-maximisation. Instead, cosmolocal scaling cultivates a diverse ecosystem of interconnected yet distinct initiatives; each adapted to its local context while benefiting from and contributing to a global commons (Figure 1).

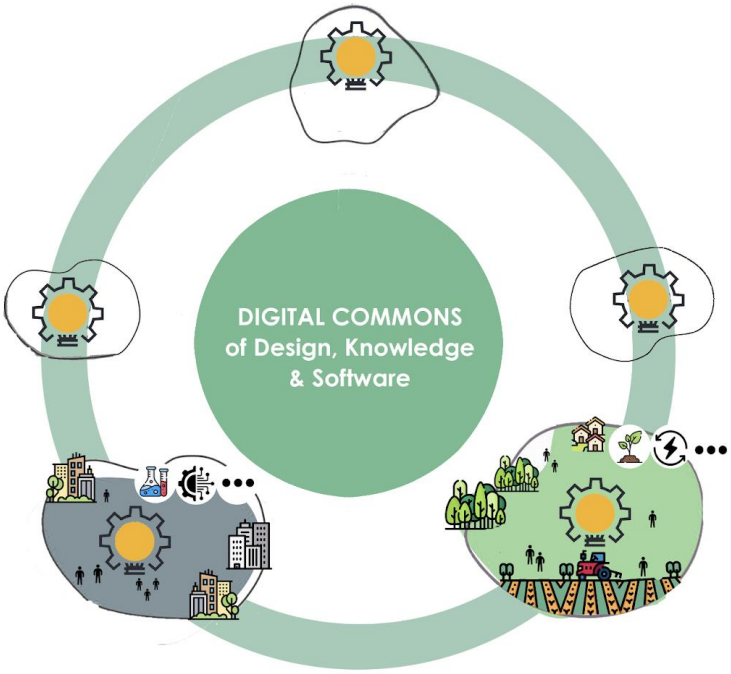

Figure 1: An overview of how diverse locally oriented but globally connected initiatives are linked through shared digital commons. Each bulb (idea/design) with a cog (manufacturing) represents a local commons-based production system. The model shows how knowledge, from agriculture and energy to robotics, can spread globally while being adapted to specific local contexts, ranging from urban to rural settings.

3. "Mid-Tech" for Scalable Production

Cosmolocal production thus emerges as a vibrant thread, weaving together the seemingly disparate strands of global connectivity and local autonomy. This novel approach to manufacturing and design presents a compelling alternative to the monolithic structures of conventional industrial production. At its core, cosmolocal production is defined by at least four key features that set it apart from its industrial counterparts (Kostakis et al. 2018).

First, it embraces design-embedded sustainability, where products are often conceived not just for immediate use, but for longevity and adaptability. This attribute echoes the timeless wisdom of craftsmanship, where objects are created to last and evolve with their users. Second, it promotes on-demand local manufacturing, bringing production closer to the point of use and significantly reducing the ecological footprint associated with long-distance transportation. Third, it employs shared productive infrastructure, where digital and physical tools are communally managed resources, so productive infrastructure is optimised. This sharing extends beyond mere tools to encompass designs and technical information, fostering a culture of grassroots innovation (Troullaki and Rozakis 2024). Fourth, cosmolocal production allows for participant-defined value systems. For example, the members of L'Atelier Paysan decided that the cooperative model better reflects and encapsulates their values. Instead, the members of Farm Hack feel that a more autonomous model of organisation better fits them,

which is why they have established a network organised around their web platforms and physical events that take place from time to time (Giotitsas 2019).

Cosmolocalism combines digital tools with local knowledge and traditional crafts in a “mid-tech” approach (Kostakis, Pazaitis and Liarokapis 2023). It leverages advanced digital design and knowledge sharing tools, while incorporating local expertise and simple techniques. The goal is to create accessible, adaptable, and repairable technologies, reducing reliance on global supply chains and prioritising longevity and ease of maintenance. Examples like a specific version of OpenBionics’ prosthetic limbs, which minimise the use of electronics and utilise the Internet and high-tech software for global design and distribution, as well as open-design agricultural tools from initiatives like L’Atelier Paysan, show how this approach can result in new, affordable solutions that integrate technological progress with ecological sustainability and social inclusion.

The mid-tech approach also challenges the idea that newer, more complex technologies are always superior. Instead, it encourages a critical examination of technological choices, considering factors such as energy efficiency, resource use, and social impact. This approach recognises that sometimes, simpler technologies or hybrid solutions that combine traditional methods with modern innovations can be more effective and sustainable.

This unique configuration allows for a balance that does not reject all technological progress, but rather seeks to harmonise it with local needs and knowledge. Cosmolocal projects thus help us reimagine scalability, moving away from the traditional capitalist model of ”scaling up” to embrace a concept of “scaling wide” or “scaling out”. This alternative trajectory of scalability embraces diversity and local adaptation while still facilitating replication and expansion. In cosmolocalism, ideas, practices, and innovations can spread widely without imposing a homogeneous template, offering a vision of post-capitalist scalability that respects and celebrates the rich tapestry of local contexts and cultures.

4. The Tightrope Walk of Cosmolocalism

The cosmolocal production, while promising, is not without its complexities and challenges. At the heart of cosmolocalism lies a fundamental tension between openness and sustainability. The ethos of free sharing that drives innovation can, paradoxically, threaten the very foundations of these projects (Druijff and Kaika 2021). Corporate entities, with their vast resources, may swoop into appropriate open designs without reciprocating or nurturing the commons from which they benefit. Some initiatives have responded creatively, experimenting with “commons-based reciprocity licenses” that demand commercial users give back to the collective pool (Bauwens and Kostakis 2014). However, the challenge of sustaining open systems in a world still dominated by closed, profit-driven models remains a tightrope walk.

Moreover, the global nature of cosmolocal networks, while a strength, can also mirror and potentially amplify existing inequalities. These networks may inadvertently flow along lines of privilege. Nodes blessed with more time, tools, and expertise may eventually dominate development, drowning out voices from less-resourced regions and groups. For example, most contributors to open hardware projects are white males from Europe and North America.

Further, legal and regulatory frameworks, designed for a world of centralised production and closed intellectual property, often struggle to accommodate the fluid, boundary-crossing nature of cosmolocal practices. Under the current liberal legal land-

scape, digital commons are unable or unwilling to scale (Shulz et al. 2024). For example, open-source hardware and community manufacturing exist in a twilight zone of legality, neither fully embraced nor explicitly forbidden. Navigating this regulatory labyrinth, while simultaneously working to reshape it, remains an ongoing challenge as cosmolocal models seek to move beyond niche applications into the mainstream.

Perhaps the most pervasive challenge is the constant push and pull between cosmolocal principles and the gravitational force of the capitalist economy in which these initiatives exist. Cosmolocal projects must constantly resist the pressure to drift towards more conventional business models or risk being swamped by corporate competitors. Maintaining fidelity to commons-based principles in the face of relentless market pressures requires commitment and creative strategies for economic sustainability.

Moreover, the engine of many cosmolocal projects – volunteer enthusiasm and labour – is a source of strength and potential fragility. While passion fuels innovation, it can also lead to burnout, threatening the long-term viability of projects. Developing robust models for sustaining engagement and fairly compensating labour remains a critical challenge. Some initiatives are charting new territory, and exploring novel cooperative structures and alternative revenue models that align with cosmolocal values.

5. De-Coupling Critical Infrastructure

Cosmolocal production depends on access to critical infrastructure. At the local level, we find that shared infrastructures like makerspaces are adaptable to different contexts. In the case of digital infrastructure, it is crucial to acknowledge a fundamental tension at its core: the dependence on large-scale infrastructures such as the Internet and its energy-intensive materiality. This dependence creates a paradox where initiatives striving for local autonomy and sustainability remain tethered to global systems that may not align with their values or long-term goals.

The Internet, comprising a vast network of servers, cables, and data centres, functions as the nervous system of cosmolocal production. It facilitates the global sharing of designs, coordinates distributed manufacturing, and fosters the creation of transnational communities of practice. However, similar to infrastructures like railroads, this digital commons is often constructed and maintained by corporate entities. It also relies on resource-intensive processes that can contradict the ecological goals of many cosmolocal projects (Muller 2024). This discrepancy raises important questions about the viability and integrity of cosmolocal models in their current form. How can we align the ideals of local empowerment and ecological sustainability with a reliance on centralised, energy-intensive digital infrastructure? What potential pathways exist for cosmolocal initiatives to evolve and reduce this dependence?

Addressing these challenges will require multi-faceted approaches and long-term strategic thinking. Several potential avenues for development merit exploration. Developing less energy demanding digital communication technologies could reduce the ecological footprint of cosmolocal networks. This might involve revisiting and updating older technologies or creating novel low-power solutions. Efforts to create more distributed, community-owned internet infrastructure, such as mesh networks, could align digital communication systems more closely with cosmolocal principles. Projects like Althea (https://hawknetworks.net/) and Guifi.net (https://guifi.net/) offer promising models for community-controlled Internet provision.

Further, while existing satellite Internet networks are predominantly owned and operated by private corporations, there is evidence that communities can also create and manage orbital space technology (Lemos and Giotitsas 2021). In addition to Internet

connectivity, satellite-based infrastructure may play a crucial role in addressing sustainability challenges on Earth (Yap and Truffer 2022). Earth-orbiting satellites provide real-time data, revealing the negative environmental impacts of "scale-at-all-cost" approaches. This data can assist local decision-making in areas such as agricultural monitoring, urban planning, and industrial development.

Shaping policy to support more democratic control of digital infrastructure could help shift the balance of power. This might include mandating open access to physical infrastructure or supporting community broadband initiatives. Broadening the scope of open-source development to encompass more of the digital infrastructure stack could reduce dependence on proprietary, corporate-controlled systems. A long-term strategy of progressively localising production and its supporting digital infrastructure could help cosmolocal initiatives align practice with principles over time.

The current incarnation of cosmolocal production represents an intermediary stage – a hybrid model that leverages existing global infrastructure to nurture more localised, sustainable practices. As these practices evolve and mature, they may develop the capability to reshape or replace the same infrastructures they currently depend upon. This process will likely be gradual and uneven, with different regions and sectors progressing at varying rates. It will require ongoing experimentation, learning, and adaptation. The challenge for practitioners and theorists of cosmolocal production is to remain clear-eyed about these dependencies and limitations while working steadily towards more fully realised versions of their vision. By confronting this paradox openly, the cosmolocal movement can strengthen its theoretical foundations and practical strategies. It can spur innovation in less unsustainable digital technologies, inspire new forms of community ownership, and contribute to broader discussions about the future of our shared digital infrastructure. In doing so, cosmolocal approaches may not only transform production but also help reimagine our global collaboration networks.

Cosmolocal scalability is not a fully realised alternative system, but an emergent and experimental set of practices. It is a work in progress, still grappling with how to interface with and potentially transform dominant economic and regulatory paradigms. Cosmolocal initiatives also serve as incubators for post-capitalist practices, experimenting with more democratic and degrowth or post-growth economic models. As cosmolocal networks develop, they could facilitate the rapid adoption of ecological production modes, addressing planetary-scale sustainability challenges through global knowledge sharing and local adaptation.

6. Charting a Course for Post-Capitalist Construction

Tsing's critique of capitalist scalability highlights its implications and contradictions as being fundamentally at odds with ecological and social realities. Despite the backdrops, the relentless pursuit of frictionless scaling not only exists within business and science-related settings, but also appears in social innovation and public policy debates and research programs (Pfotenhauer et al. 2022). Yet, in a world facing overlapping crises, the need for alternative ways to spread positive innovations and practices is urgent. While traditional approaches to scalability prioritise speed, disruption, and homogeneity, cosmolocal scalability arguably offers an emergent alternative trajectory that points toward more democratic, inclusive, and sustainable modes of production.

Cosmolocal scalability represents a different approach to scaling, viewing scales (local, regional, or global) as neither fixed nor hierarchical (Grillitsch et al. 2024). Rather than merely shifting activities from one vertical scale to another, this approach emphasises the active, intentional, and purposeful engagement of actors in reshaping scalar boundaries to more effectively interact with and influence social, economic, and

political processes (Grillitsch et al. 2024). Central to this process is the concept of human agency — the capacity of individuals to make tangible impacts on the world (Gregory et al. 2010) — enabling them to transform existing structures and underlying rationales over time, even as they operate within established frameworks (Grillitsch et al. 2024).

Drawing on Antonio Gramsci's (1971) thought, cosmolocal scalability could be seen as a potential avenue for building counter-hegemony against capitalist modes of production and expansion. Gramsci emphasised the importance of ideological struggle in civil society as a precursor to transforming political and economic structures. Cosmolocal initiatives can become sites for developing new "organic ideologies" that could challenge capitalist notions of scarcity, competition, and endless growth.

The global networks of cosmolocal projects could be understood as nascent forms of what Gramsci called a "collective will" – a shared vision and set of practices that unite diverse groups in pursuit of systemic change. By fostering direct participation in the design and production of goods, cosmolocal approaches may help overcome the alienation inherent in capitalist production, creating more engaged and empowered citizens.

Crucially, cosmolocal models align with Gramsci's strategy of building counter-hegemony through a "war of position" rather than a frontal assault on state power. By creating alternative economic practices and fostering new forms of social relations within the interstices of the existing system, cosmolocal initiatives can gradually erode the legitimacy and perceived inevitability of capitalist modes of production. The role of "organic intellectuals" is vital in this process. Designers, engineers, and community organisers involved in cosmolocal projects can serve as these organic intellectuals, articulating new visions of production and social organisation rooted in the practical experiences of their communities. Their task is not only technical but deeply political and cultural – helping to forge new common sense around ideas of value, work, and human flourishing.

To be sure, cosmolocal models face significant challenges and tensions as they interface with dominant systems. They should not be uncritically celebrated as a fully-formed alternative. But they offer vital spaces of experimentation for post-capitalist practices. As Gramsci recognised, building a new hegemony is a long-term process that requires patience, strategic thinking, and the ability to work across diverse sectors of society. Cosmolocal scalability is not just a technical shift but a cultural one. It involves different ways of relating, collaborating, and conceptualising value. As such, it connects to broader movements for economic democracy, ecological sustainability, and social justice. The task ahead is to consciously develop these connections, creating what Gramsci called a "historic bloc" – an alliance of social forces united around a common transformation project.

Looking forward, proponents of cosmolocal approaches must grapple with several key challenges. These include developing robust economic models that can sustain and expand these initiatives while resisting co-optation by capitalist logic, and bridging divides between urban and rural contexts, as well as between the global North and South, to create genuinely inclusive collaboration networks. Another vital task is engaging with policymakers and institutions to create legal and regulatory frameworks that support, rather than hinder, commons-based production. Additionally, cultivating new education and skill-sharing forms can spread the technical and social knowledge needed for cosmolocal production. Building alliances with labour movements, ecological movements, the open-source movement, the cooperative movement, and other

progressive forces is essential to situate cosmolocal practices within broader struggles for systemic change.

By addressing these challenges, the cosmolocal movement may move beyond isolated experiments to become a significant force in shaping post-capitalist futures. As Gramsci reminded us, fundamental social change requires both pessimism of the intellect – a clear-eyed assessment of current realities – and optimism of the will – the determination to create alternatives even in the face of daunting odds. Cosmolocal scalability, with its blend of technological innovation and social reimagining, offers one promising path forward in this crucial task.

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About the Authors

Vasilis Kostakis
Vasilis Kostakis is Professor of Technology Governance and Sustainability at TalTech's Ragnar Nurkse Department of Innovation and Governance and a Faculty Associate at Harvard University's Berkman Klein Center for Internet and Society. He is the founder of the P2P Lab and a founding member of the "Tzoumakers" rural makerspace.

Lucas Lemos
Lucas Lemos is a PhD candidate at TalTech's Ragnar Nurkse Department of Innovation and Governance. He is a co-founder of the Commons Kernel Lab, and fellow at the P2P Lab.

Asimina Kouvara
Asimina Kouvara is a Junior Research Fellow at TalTech's Ragnar Nurkse Department of Innovation and Governance, a fellow of the P2P Lab, and member of the "Tzoumakers" community.