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DIGITAL COMMONS AS ALTERNATIVE SYSTEMS OF VALUE

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Executive summary

This policy brief examines the nature, the roots and the role of digital commons at national, European and global level.

Digital commons can be defined as intangible resources shared among a community which are freely accessible to all; used and reused by “commoners” engaged in collective “commoning practices” for managing open data, source codes, and standardization. They find their roots in free internet and open sharing discourses, and can be observed in different domains, among which legal, cultural, economic domains as well as governing bodies, as will be further detailed in the paper.

Digital commons are important because they provide alternative systems of value to manage ownership rights and resource property, to access global information and knowledge, to create cooperative and innovation-based peer production models and to govern hybrid communities between the State and the market in global interconnected environments.

Digital commons are also digital sovereignty enablers as they support the creation of more resilient, efficient and innovative digital infrastructure and tools. They also have the potential to democratize digital sovereignty at European level by promoting the co-construction of algorithms that are more representative of society’s diversity.

However, digital commons are facing three main challenges to reach their full potential. First, regulatory uncertainties can be detrimental to their development and protection as the proliferation of licenses, sometimes incompatible with each other, makes ownership rights management difficult, while there is a lack of harmonized value measurement systems and governance processes at European level. Second, clear incentives have not yet been set at policy level to preserve the independence of digital commons. Digital commons face capture risks as they are not only alternatives for software production but also additional tools to help corporations produce the best possible software. However, their negotiation power and financial leeway is much weaker than corporations since they rely on voluntary-based participation. As a result,

their “boundary organizations” (O’Mahony & Bechky, 2008) are much less developed and expose them to maintenance and pollution risks. Third, communication gaps are still too important between digital commons and tangible commons, which is detrimental to their development and protection since they both grow in synergies with each other and are deeply intertwined.

To overcome these challenges, this paper proposed three main areas of public policy recommendations:

- Build regulatory certainty for digital commons through a harmonized next generation of public policy
- Focus European funding and investment thesis on digital commons’ boundary organizations
- Use the European foundation for digital commons to reinforce ties with tangible commons

1. Introduction

The 2016 film *Arrival*, directed by Denis Villeneuve, showcases “heptapod” aliens visiting Earth and placing 12 spaceships across the globe. Faced with this unfamiliar, extraterrestrial “threat”, humans cast their differences aside, mustering their resources to save their collective destiny by decrypting the aliens’ cyclical language. Though fictional, *Arrival* hints at the recurring challenge of coordinating and collaborating in multi-layered, complex, interconnected and heterogeneous environments to share and manage tangible and intangible resources.

This paper seeks to address to what extent and under which conditions digital commons as alternative systems of value and digital sovereignty enablers can contribute towards enhancing resource sharing and management in global, regional and local settings.

Digital commons can be defined as a resource, a group or a practice:

- As resources, digital commons refer to the distributed and communal production of information and knowledge shared between a community which may also be freely accessible to third parties.
- As groups, digital commons refer to “commoners”, which are a community of people building on resources, reusing them, and governing their use in a collaborative manner.
- As a practice, “commoning” (verb) refers to the process and activity of managing resources together in a way that is subject to open source and data, as well as standardization. This practice favors the behaviors behind the use and reuse of intangible resources rather than regarding exchanges as transactional commodities (Fuster Morell, 2015).

In a “common-based” perspective, barriers between consumers and producers should be as low as possible, since the system’s development hinges on their joint ability to manage collectively owned and freely available resources.

Digital commons are important in this perspective for two reasons.

First, they enable the creation of "alternative systems of values" with new processes to produce and maintain dematerialized global resources in a collective and distributed manner. It is suggested that digital commons emerged as a response to capitalistic rules such as Intellectual Property (IP) law enclosures (de Rosnay & Stalder, 2020) and/or even as a product of capitalism to produce more efficient products, with the Linux kernel (Birkinbine, 2020). Digital commons were first mentioned in the late 1950s within "hobbyist communities" using the COBOL computer language, developed by Grace Hopper in 1959. They then quickly got adopted as the new paradigm for producing information goods in the field of software development in the 1980s. Today, 78% of businesses use it for their operations and 96% of existing applications have at least one open-source component.

These alternative systems of value are observed in four different domains:

- Legal: Where alternative licensing models from copyrights are created to include producers and consumers of content.
- Cultural: Where authorship is no longer individual and creators can use and reuse previous work to grow, enhance and preserve cultural works. For example, remix musical creations can only exist if previous contributions are freely available and authorship shared between creators.
- Economic: Where goods and services are valued according to socially-beneficial objectives they are fulfilling and not according to the accumulation of production factors.
- Governance: Where communities and user engagement are seen as emerging foundations of governance models for managing shared resources.

Second, digital commons have the potential to strengthen and democratize digital sovereignty at European level.

Digital sovereignty refers to the ability of European authorities and European states to ensure technological independence in strategic industrial sectors.

Public policies objectives for digital sovereignty are therefore twofold:

- Ensuring that foreign technological giants respect European norms and values when operating in Europe and that European user data and freedom is protected within the digital network;
- Maintaining technological independence to reduce dependencies in strategic sectors such as software or semiconductors and to remain competitive in these sectors at global level.

Digital commons are useful to achieve these policy objectives since they are collectively managed and designed by civil society and experts. They provide a viable, and sometimes more efficient alternative to state and firm's enclosure strategies.

To enhance digital sovereignty, states, firms and individuals can leverage digital commons to build digital tools more efficient and innovative while remaining consistent with liberal and democratic European values:

- European public administrations can use digital commons resources to increase their security through international collaborations and their efficiency through network effects;
- European firms can leverage digital commons to co-create algorithms, products and services more aligned with the diversity of their customer base and more innovative through knowledge networking effects;
- European citizens can join digital commons to gain more control of their personal data and of algorithms underpinning goods and services they have access to by co-building and co-maintaining them with firms and administrations.

To democratize digital sovereignty, states, firms and individuals can also actively contribute to the development of digital commons for building tools more representative of civil society's aspirations and diversity.

Therefore, as demonstrated by work carried out on digital commons during the French Presidency of the EU Council, strengthening digital commons is an essential lever of digital sovereignty for all European states, firms and citizens.

However, digital commons face three significant challenges, which this paper seeks to address from a public policy perspective.

First, gaps in existing and future legal frameworks need to be addressed to adapt to the specificities and evolution of digital commons. Ownership rights remain unclear with the proliferation of digital commons' licenses often incompatible with each other. Value measurement systems and dedicated governance processes are not designed to support tripartite environments with policymakers, corporations and commoners built on alternative models between the state and markets. Furthermore, the specific principles to be implemented, the types of digital commons they should apply to, and the precise methods for their operationalization at the European level remain ambiguous. Uncertainties persist regarding the efficacy of the "digital commons first" principle advised by the working group under the French Presidency of the European Council in June 2022.

Second, digital commons are still undersupplied compared to the value they bring to "networked societies" (Pohle & Thiel, 2020, 8). Because of their nature, digital commons are more consumed than they are managed and maintained and they need targeted public support for both tasks. This requires policy makers to shift from an announcement-based posture towards a more practical hands-on approach focused on infrastructure development and governance of digital commons. This paper argues that the best way of achieving this objective is to focus available funding on creating "boundary organizations" (O'Mahony & Bechky, 2008) in successful digital commons to preserve their independence and encourage maintenance efforts. To be more efficient, digital commons need to be properly maintained. They also need to provide enough incentives to communities of commoners to actively contribute to their operation and long-term maintenance. Security issues have also been cited as persistent in a context where open-source software is often maintained by volunteers

who are not always recognized for their value and thus lack incentive to remain involved. In addition, digital commons projects predominantly revolve around large international corporations, with the exception of a few open projects (e.g., Wikipedia, discussed later). This can create damaging negotiation power asymmetries or economic inefficiencies and potentially weaken European positions compared to foreign dominant market players (GAFAM and BATX).

Lastly, digital commons will reach their full potential if they are connected to tangible commons and/or the general public, since they contribute to the building of global commons goods in “post-growth” societies. However, most discussions today take place in expert or highly specialized communities (e.g., regulators, open-source software developers, business leaders). Many of these communities are technical in nature and may thus be relatively inaccessible to the general public, creating a gap that is increasingly difficult to close between both worlds.

This paper seeks to provide a comprehensive definition of digital commons and clarify their benefits for the economy and digital sovereignty. Building on ongoing digital commons initiatives at national, European and global level, , it then goes into further detail by analyzing the importance and challenges of digital commons at European level. It concludes by making policy recommendations to address these challenges, expanding the existing recommendations provided by the European working group on digital commons during the French Presidency of the EU Council in June 2022.

2. Why are digital commons important?

2.1. Defining digital commons

Since a universally accepted definition of digital commons is currently lacking, this section seeks to define digital commons using a dual perspective of practical/applied and theoretical approaches.

From a practical/applied standpoint, digital commons can be characterized as open, non-rival and non-exclusive productions of data, source-code and standardization (dematerialized resources) governed in a collaborative way through informational capacity and technological innovation .

1. On the infrastructure level, they refer to readable texts of computer programs available freely for anyone who wants to use them (Schweik & English, 2012). These include free/libre and open-source[1] softwares (FLOSS) like Linux. Currently, flagship open-source projects are being developed at global level such as the “James” solution of the IMAP protocol for mail servers hosted by the Apache Foundation, or the Software Heritage project developed by the Preuves laboratory as a universal source-code archive.

2. On the application level, the architecture of the internet and associated protocols and technical norms can be considered as digital commons, since they are collectively developed and maintained by developers, engineers, and technicians. They include open-source licensing solutions compliant with open-source definitions[2] such as the GNU-GPL, the Apache 2.0 license, the

[1] https://opensource.org/osd : open work should: (1) respect open license terms or its public domain status; (2) be available as a whole and without charge; (3) be “machine-readable” so that the elements can be easily accessed and modified; and (4) contain no restrictions on the use of the open format meaning it can be fully processed with at least one libre open-source software tool.
[2] This means that the software must be freely used, modified, and shared.

BSD-2 and BSD-3 licenses, the MIT license or the Common Development and Distribution license, among others.

From a more theoretical standpoint, digital commons stem from the free culture movement which promotes the freedom to distribute and modify the creative works of others (Lessig, 2004), as well as a free software philosophy which promotes "digital rights", as fundamental rights[3] (Stallman, 2002). "Digital rights" refer to basic human rights in the internet era among which online privacy and freedom of speech, and have been refined at European level by the European digital rights and principles. Digital commons are considered to be equipped with "postcapitalist potentials" (Fuchs, 2021), since their objective for common-based resource management is to organize economy and society "beyond" market and state-based approaches, as "an alternative between market-based approaches and bureaucratic forms of organizations" (Bollier & Helfrich, 2012). They can also be understood through a Marxist lens as a form of "digital labor" (Birkinbine, 2020). Indeed, some digital commons have been incorporated into digital capitalism as part of capitalist production mechanisms. For example, companies like Red Hat have business models relying on FLOSS and others like IBM, Google, Cisco, Intel or Samsung are the largest contributors to Linux. As a result, power dynamics have arisen between corporations and developers/ engineers involved in digital commons. Within this context, the reuse of the content produced can be viewed as a form of digital labor. This labor values the creation of digital commons integrated within capitalist frameworks.

Viewed through the lens of value creation, the more a digital commons is shared, the greater its value becomes. This makes digital commons "anti-rival goods" and thus protects them from free-riding behaviors (Weber, 2004). For example, not everyone is a code contributor in the Python-based SciPy project, but the project gains value since everyone is contributing to bug fixing. Digital commons favor the use and re-use of information to enrich it continuously with "prosumers" partaking in the online

[3] The Free Software Foundation makes this distinction using the analogy to think of "free" as in "free speech" and "freedom" (i.e., a concept) rather than "free beer" (i.e., gratis).

community by using its resources and producing value at the same time (Fuster Morell, 2015), rather than exchanging information as a commodity per se.

Many digital commons projects rely on FLOSS, of which business models can be very diverse. They can involve dual-licensing configurations where distribution is open for non-profits and payable for others, such as MySQL, or consulting services or distribution and/or licensing services of an open-source software or licensing model, such as RedHat. They can also be hybridized with proprietary software[4] through vertical developments using open-source software as a base upon which proprietary software is built, (e.g., Google with Linux core support). Alternatively, horizontal arrangements exist where corporations/businesses involve themselves in open-source projects, such as IBM's WebSphere application which enables users to build their own apps using the Apache open-source software (Birkinbine, 2020).

Digital commons can also be understood as part of polycentric arrangements formed by multiple layers of "nested enterprises" where authority and power are distributed between different decision-centers requiring effective coordination between them (Ostrom et al. 1961). In the internet configuration of a "network of networks" (Schewik, 2010), if no technical or financial fixed costs are needed to add a new service, an audience and community are necessary for the service to be viable. This means that the network's robustness heavily relies on global interconnections and its interoperability (de Rosnay & Stalder, 2020).

2.2. Digital commons as alternative systems of value

Digital commons provide alternatives of value measurement and creation to market and state-based systems from four different perspectives. If used and reused at their full potential, they could contribute to building more resilient "post-growth" systems to address current socio-ecological challenges (Siddarth & Weyl, 2021).

[4] Proprietary software are software whose use and reuse is controlled directly by their owners under copyright applicable law.

First, from a **legal standpoint**, digital commons have enabled the development of more appropriate licensing models for the networked distribution of informational resources. Indeed, IP rights can be considered as an “enclosure” (Du Rosnay & Stalder, 2020) which presents barriers to the accessibility of information and knowledge. In contrast, digital commons are seen as an alternative to circumventing the IP rights “enclosure” as they enable collective sharing and reusing of information and knowledge through open licenses. These new models can be qualified as “property-based” digital commons (Broumas, 2017).

They refer to permissive licenses and copyleft licenses that both allow for unlimited use and reuse of a licensed work but under different conditions: it has to be correctly distributed for permissive licenses (for example the Apache license) whereas it has to be distributed as open-source only for copyleft licenses with strong, flexible or weak protection (for example the GNU General Public License).

Indeed, the legal framework of copyright does not enable taking full advantage of collectively produced online resources since it separates producers of digital content from consumers by creating artificial boundaries between them. On the one hand, producers of digital content are given the right to control the reproduction and distribution of the goods they create. On the other hand, consumers of digital content are monitored by a vertical industry and their interactions with content are intrinsically passive. However, in the “information society”, consumers can be considered as “users” since their utility for the digital commons increases with their degree of activity and are therefore inherently active. The more they contribute to the content (e.g., reporting bugs, suggesting improvements, participating in decisions), the more valuable the final product becomes.

In practice, copyright proved inadequate as it led to the underutilization of knowledge in cases of previously unregulated copyrighted work such as databases in Europe (de Rosnay & Stalder, 2020). This underutilization of resources has been qualified as “the tragedy of anticommons” (Heller, 1998), and describes a situation where rational economic agents waste informational resources by underutilizing them. Notably,

copyright does not account for second-hand informational resources derived from copyrighted content creation such as remixed music or documentation that rely on the reusability of previous work.

For example, Creative Commons are licenses that provide a standardized framework for any creator to grant public permission to use and reuse their work while still complying with copyright law. This framework is composed of six licenses that are more or less permissive. It was created in 2002 by Lawrence Lessig and others after the US Supreme Court[5] upheld the constitutionality of the 1998 Sonny Bono Copyright Term Extension Act (CTEA) extending the duration of copyrights by 20 years. This decision was detrimental to internet publishers since they relied on the public domain to promote and share their work. Independent online booksellers and others, among which the Free Software Foundation led by Lawrence Lessig argued that this extension restricted freedom of speech by violating the First Amendment and the requirements of the Constitution's Copyright Clause. The Constitutionindeed conditions Congress prerogative to promote "Science and useful Arts" to its engagement to secure exclusive rights for creators "for limited times".

Creative Commons was therefore built as a nonprofit organization providing convenient tools for creators to share their work by remaining consistent with Copyright law in the United States. This led to the development of new approaches to authorship and creativity built as a balance between individual contribution and collective enablement (Stadler, 2022). Today, Creative Commons are used by c. 2 billion works online through 9 million websites. They are also adopted by governments and public institutions as global standards for copyright licenses. Creative Commons have also inspired many cultural movements and ideologies such as the "intertextuality" movement advocating for a collective dimension of literary work in digital networks (Woodmansee, 1992; Turkle, 1995).

[5] Eldred v. Ashcroft - 537 U.S. 186,123 S. Ct. 769 (2003)

Second, from a **cultural standpoint**, resource-based digital commons (Broumas, 2017) are useful to create "new forms of knowledge" (Jullien, 2020). They are characterized by an abundant stock of available intellectual resources.

Resource-based digital commons include shared libraries like the Wikipedia online encyclopedia created in 2001 with over 25 billion page views, over 150 languages and 1.8 edits per second as of 2019. They also include online databases like Open Street Map, Open Food Fact, Tela Botanica and platform cooperatives like Resonate on Github, Fairbnb, Taxiapp on Github, Stocksy United or Loomio for collective decision-making. Resource-based digital commons may also have broader societal goals as seen through the ongoing Apollo Auto Foundation project which hosts ethical discussions regarding the use of autonomous vehicles.

For example, the GLAM-Wiki initiative which helps cultural institutions share their resources on the Wikimedia Commons repository to showcase public domain work. This happens after the 70-year Copyright term has passed since the death of the author in the EU and at least 50 years for all members of the World Trade Organization (The Royal Society, 2012). These projects are deeply rooted in the culture of an "information society", where the barriers between producers and consumers of knowledge are progressively lowered as both groups become "infrastructural components" of social development (Birkinbine, 2014).

Third, from an **economic theory standpoint**, relational-based digital commons (Broumas, 2017) can be understood as new cooperative and innovation-based peer production models (Benkler, 2002/2006) based on collective contributions rather than market signals (Fuchs, 2021) and specific "design principles"[6] (McGinnis & Ostrom, 1992). These models promote collective labor dynamics through "commoning" (Linebaugh, 2008) to assess human capital value. These dynamics have enabled the emergence of commons-based peer production (CBPP), which are decentralized, collaborative, and non-proprietary resource management systems (Benkler, 2004).

[6] These "design principles" encompass various aspects, such as the definition of the scope of the resource and the community, the provision of mechanisms for resolving conflicts, and the recognition of the rights of the commons by external actors. This is discussed in further sections.

When applied to economic dependencies in Europe, their value lies in the fact that they provide alternatives to transactional-based solutions based on data collection. Their cost is not transactional but behavior-based and relies on collective maintenance and contribution.

Relational-based digital commons can be understood by using Marx's analysis of cooperative labor and the use of machinery as a tool of resistance against the undesirable encroachments by capital to exploit labor (Birkinbine, 2020, p.35). According to Marx, the commodity contains two types of value (use and exchange) both created by human labor (which itself has become commodified by capital). In the case of digital commons, the "sense of community" behind FLOSS digital labor prevents it from being alienated from its production (Birkinbine, 2020). Building on these Marxist considerations, de Angelis (2017) posits the "commons circuit of value" to demonstrate how "commoning" practices, if reproduced through time, can create value and social change. The model combines people (A) collectively owning commonwealth (CW), that can be commodified (C) or non-commodified (NC). The commons are constituted by this dual relationship between the association (as subjects) and their commonwealth as objects (Cs); and are reproduced in the long-term through "commoning" (cm). Going further, some understand value as a common itself (Pazaitis et al., 2022) since its definition is intrinsically part of a collective agreement as a shared social goal. Value is therefore derived from contribution and reciprocity in digital commons towards sufficiency to achieve a specific social or ecological purpose[7] rather than maximization through production factor accumulation.

Fourth, from a **governance standpoint**, process-based digital commons (Broumas, 2017) place communities and engagement as new pillars for efficiency and sustainability. Notably, their sustainability is understood as their ability to promote and maintain "commoning" practices (Linebaugh, 2008) in the long-term.

[7] Cosmolocalism refers to this conception of value based on global networks of co-existing local communities putting human needs first to reinvent cultural diversity (Schismenos et al., 2020).

On the one hand, community boundaries are both determined by producers and users of digital content. This shifts the challenge towards the availability of digital resources rather than their potential exhaustion and calls for the creation of "boundary organizations" (O'Mahony & Bechky, 2008) to perform centralized services that are essential for their efficiency (e.g., legal, financial or communication services). On the other hand, digital commons sustainability is increasingly reliant on the interrelations between producers and users. This calls for governance processes that allow for large-scale participatory decision-making in a transparent way, which can be tough in a landscape where cultural differences and loose connections between individuals can currently be particularly challenging (de Rosnay & Stalder, 2020).

Leading organizations are establishing standards aimed to regulate process-based digital commons on the global level. These organizations include, inter alia, the Linux Foundation, the Apache Foundation, the Wikimedia Foundation and the Wordpress Foundation. FLOSS is also coordinated by the Internet Engineering Task Force (IETF) hosted by the Internet Society for internet standards and the World Wide Web Consortium (W3C) founded by Tim Berners Lee in 1994 to promote the standardization of web technologies through consensus building within communities.

According to the 2022 European report of the working team on digital commons "Towards a Sovereign Digital Infrastructure of Commons", investments in open-source software represented €1 billion in 2018 for a €65 to 95 billion positive impact on the economy. Although the impact of digital commons has yet to be measured, the study showed that increasing contributions to open-source code by 10% can generate an additional 0.4 to 0.6% of GDP for the European economy.

2.3. Digital commons as enablers for digital sovereignty

Digital commons can also be considered as powerful tools to enhance and democratize digital sovereignty for policymakers.

Enhancing digital sovereignty refers to building more resilient and efficient tools with digital commons to protect European digital infrastructure and European liberal and democratic values at global scale.

Democratizing digital sovereignty (Pohle & Thiel, 2020) refers to co-developing more representative tools of civil society aspirations and diversity to increase and maintain the legitimacy of the existing digital strategy employed by the EU.

2.3.1. Digital commons to strengthen European digital infrastructure

Through international collaborations, digital commons can be used to strengthen European digital infrastructure.

On the European level, a digital policy architecture has been built collectively by European public agents, the private sector, and open-source communities. This is best exemplified in the "Think Open" vision of the European Commission Open-Source Software Strategy for 2020-2023. On the operational level, funds from Horizon Europe are being released through calls for proposals and the Next Generation Internet initiative is providing resources to support digital commons building blocks and FLOSS communities.

On the global level, the GovStack initiative[8] was launched as a "public-private-common partnership" to generalize the use of efficient, affordable, accountable and more secure digital solutions to accelerate the digitization of governments. It is supported by the International Telecommunications Union (ITU), the Estonian Government, the German Ministry for Development, and the Digital Impact Alliance.

2.3.2. Digital commons to build more efficient digital tools

[8] The objective of the GovStack initiative is to create a sustainable digital infrastructure based on the UN Sustainable Development Goals (SDGs) and to help governments create human-centered digital services by using digital commons to build more inclusive and resilient societies. The GovStack digital common also simplifies digital transformation for governments and reduces its cost through time.

Digital commons encourage innovation through network effects thereby contributing to designing and building more efficient public services. They also provide more interoperability than market dominant players (GAFAM and BATX).

In France, the Free Software and Digital Commons Action Plan launched in November 2021 by the French Secretary of State for Digital Affairs had set ambitious objectives for the exploitation, opening and circulation of data, algorithms and public source codes for the benefit of users, researchers, innovators and citizens (European digital assembly, June 2022). It is driven by a Free Software expertise unit within the Etalab department of the French Interdepartmental Directorate for Digital (DINUM) and supported by the TECH.GOUV program. Specifically, the LABEL mission of DINUM is responsible for improving the knowledge, use, and design of digital commons in the public sector. The Free software expertise unit of ETALAB is responsible for guiding the French administration to developing more FLOSS initiatives. The DINUM TALENTS mission uses digital commons and FLOSS to encourage digital talents to consider career opportunities within the public sector. Several concrete projects have emerged from this initiative. For example, the Open Terms Archive project (led by Elsa Trujillo within a team directed by Henri Verdier) highlights shadow areas of digital services operators by looking at general terms and conditions. In this digital common, a volunteer community is collectively archiving and updating over 600 contractual documents and over 280 online services every four hours.

Other EU Member States have also implemented their own national digital commons projects. The German Federal Ministry of Economic Affairs and Climate Action launched a dedicated sovereign tech fund in 2022 that is actively engaging with open-source communities to be more flexible in project funding, and ensure even smaller ones receive appropriate funding. In Italy, an “open data by default” policy was introduced and developers were involved in public policy to integrate open-source technologies to private and public services. Northern European countries are also relatively advanced on FLOSS as seen from the Nordic Institute for

Interoperability Solutions' (NIIS) operating model which is derived from digital commons practices focused on experience sharing and cross-border collaboration.

2.3.3. Digital commons to democratize digital sovereignty

For citizens, digital commons are also a lever to strengthen their autonomy as employees, consumers, and users of digital resources, because they enable citizens to use and reuse material freely and contribute to their substance. Moreover, it gives them access to auditable code thereby avoiding code manipulations for commercial purposes.

At national level, the Software Heritage digital common developed by the laboratory Preuves, is building an archive of software source-code for the benefit of society as a whole, as a "cultural heritage" (di Cosmo, 2022). With over 12 billion unique source code files from 180 million projects worldwide, it combines several methods to archive all available source codes produced to date. This is first done by building a harvester to collect content from collaborative platforms like Github or distribution platforms like Debian based on source-code readily available online. It is then followed by setting up a process of computer archaeology to collect source codes from old software that is no longer available online (Software Stories project with UNESCO and University of Pisa to highlight historical elements on source code). Then, by building connecters (*listers*) to identify available source-code projects and converters (*loaders*) to encode all the different formats in a universal data structure based on Merkle tree construction, with a cryptographic ID ensuring the integrity of each software artifact. This is given the absence of a standardized protocol to interact between software development and distribution platforms.

At European and global level, the digital public goods alliance (DPGA) was launched to gather various expertise from foundations and think-and-do tanks for the common good. It is jointly supported by the Norwegian Agency for Development Cooperation (Norad), the UN Development Program (UNDP) and the UN International Children's Emergency Fund (UNICEF).

3. The challenges faced by digital commons

3.1. Regulatory uncertainties for digital commons' protection and development

Open-source software is widely used today as 78% of businesses use it for their operations and 96% of existing applications have at least one open-source component[9]. However, existing and upcoming regulations still don't account for all their specificities and there is no dedicated body at European level to ensure their development and their protection.

3.1.1. Regulatory gaps to address specificities of digital commons

Judges in Germany, the Netherlands, Spain, Belgium, and Israel have been testing and applying GNU-GPL and CC licenses with success. However, this need is not standardized yet at European level.

Existing regulations are not designed for introducing a "digital commons first" principle as recommended by the working group of the French Presidency of the European Council in June 2022.

On ownership rights, the proliferation of available licenses and their related information costs are detrimental to free culture and informed consent (Du Rosnay, 2009). Not only can license clauses be incompatible with contract law and copyright to some extent, but also between them. First, numerous formats (machine-readable, human-readable and legal code) can carry legal incompatibilities between them, such as specific limitations only available in the middle of the code. Second, different licensing options coexist with provisions that can be incompatible between them, for example between the Share Alike 1.0 work with an Attribution Share Alike 2.0

[9] https://blog.gitnux.com/open-source-software-statistics/#:~:text=78%25%20of%20businesses%20are%20using%20open%2Dsource%20software.

because 4.b provisions. Third, licenses are built on an incremental model with successive versions that can create incompatibilities between licenses carrying the same optional elements, being for collaborative or deliberative works. Fourth, although the porting process – the possibility to relicense an adaptation under another jurisdiction to facilitate local implementation – ensures licenses' adaptation to various jurisdictions, this creates contract law issues since licensors are still expected to consent to the adaptation of their work under different and non-identified yet terms. Lastly, BY-SA licenses can also prove incompatible with other open content licenses such as the Free Art License or the Digital Peer Publishing License. The European Decentralized Citizens Owned Data Ecosystem (DECODE) delivered in 2019 provides a review of licensing options for digital commons and artifacts to avoid license incompatibility and possible violation of third party rights, but could be further simplified and accessible to wider public.

On value measurement systems and governance processes, reciprocity and contribution are still not standardized in local and regional regulatory landscapes. For example, no national regulatory framework sets a norm for providing the necessary infrastructures to host and create digital commons works; participation is open to all based on voluntary efforts (Du Rosnay, 2012). This is detrimental both to vertical integration of digital commons in existing infrastructures and horizontal arrangements between related communities to maintain and contribute to digital commons in the long-term. Since markets and digital commons "grow in synergy" (Berlinguer, 2021), future regulatory frameworks will have to be designed to manage tripartite environments (markets, governments and communities) and compensate for each failure and shortcomings of these stakeholders.

3.1.2. In upcoming regulations, is a "digital commons first" principle enough?

The last recommendation of the European working teams on digital commons' was to promote a "digital commons first" principle at European level, by establishing a normative requirement to always consider open-source or open-data solutions *before* implementing a new public service.

This recommendation is supported by three arguments:

- A digital commons first principle will enable the institutionalization of a public infrastructure approach in digital commons'-based production to avoid over production of resources and predatory behaviors on resources already produced;
- A digital commons first principle will generate expertise and innovation at European level through network effects enabling to make the best use of digital commons and to receive all updates and improvements before competitors;
- A digital commons first principle will foster and democratize contribution and reuse of digital commons therebay engaging citizens to contribute to their long-term development and protection.

However, is a digital commons first principle alone sufficient to meet these objectives? What type of open-source and open-data solutions should be considered first and for what purpose? Should the digital commons first principle follow Stallman or the Torvalds' vision? What about semi-commons, shared infrastructures and hybrid ecosystems between the State and the market creations and sustainability? Many questions remain unanswered making the implementation of this recommendation difficult on-field.

3.2. No incentives to preserve independence of digital commons

3.2.1. Digital commons are facing capture risks

Different philosophical visions have been put forward regarding how digital commons should promote the use and re-use of dematerialized resources. These differences are illustrated by the philosophical divergence between Richard Stallman and Linus Torvalds on FLOSS production. Richard Stallman's 1985 "GNU Manifesto"[10] advanced a moral claim against corporations that used proprietary software, promoting the freedom of sharing as a fundamental right. Stallman therefore established "Four Freedoms" related to code: (1) Freedom to run the software for any

[10] After being denied access to the Unix code by AT&T, Stallman chose a recursive acronym of Gnu's Not Unix.

purpose; (2) Freedom to study and change the program; (3) Freedom to redistribute copies of the program if it helps another person; and (4) Freedom to distribute copies of the modified program to other persons.

This vision was particularly relevant in a context where the internet infrastructure was based on FLOSS and open-source servers, and where these servers were the first source of innovation in the World Wide Web.

Linus Torvalds took a more pragmatic stance by enmeshing digital commons in the process of capitalist production (Birkinbine et al., 2020). He wanted to complete the Linux kernel in the best possible way, even if it involved large corporations like Microsoft and IBM, since they were already actively taking part in its construction and doing so efficiently. He therefore developed the Linux[11] operating system to help reduce redundant labor when individuals work on the same pieces of code – whether open-source developers or large corporate members. As a result, digital commons emerged both from an anti-corporate stance to promote genuine free software philosophy (*libre* vs. *gratis*) and from joint market-based and "commoning" practices to produce the best software possible.

Digital commons are very attractive for large corporations since they enable the building of more robust infrastructures in multi-faceted markets with freely available collective skills. This creates synergies between corporations/businesses and digital commons production. RedHat is an interesting example of a FLOSS product being incorporated in corporate strategy, in which a commercial offering (Red Hat Enterprise Linux) was used to fund digital commons innovation project (Fedora) (Birkinbine, 2020; Chapter 4). In this regard, the market artificially reintroduces scarcity features in digital commons, that are not naturally affected by them.

More broadly, multiple arrangements between digital commons and the market can arise in several forms:

[11] Derived from "Linus" (his first name) and "Minix" (the operating language with which he was working)

- "Semi-commons" where corporations/businesses and digital commons coexist and grow in parallel
- Shared infrastructures where digital commons such as FLOSS are used as a component of market production
- Ecosystem creations where a crucial layer of the industrial ecosystem such as the operating system for the mobile phone industry is "decommodified" to concentrate on a complementary adjacent market (Berlinguer, 2021).

Although there may be mutual interests from which both corporations/businesses and digital commons may benefit, the relationship is always detrimental to commoners since they have less negotiation power and financial leeway.

3.2.2. This risk comes from the absence of incentives to enforce "boundary organizations"

The concept of "boundary organizations" (O'Mahony & Bechky, 2008) is used to understand how digital commons maintain negotiation powers over market-driven organizations and sets up the right boundaries to remain independent and keep their creative autonomy. Digital commoners must defend their ownership rights, governance processes, membership systems and control over production against commercial interests of corporations using them that might not be compatible with their project. However, this position is very difficult to maintain in a context where contribution is voluntary-based and funding often insufficient compared to use and reuse of digital commons.

As a result, digital commons are often exposed to two operational weaknesses:

- First, contributors are underinvesting their time in their daily maintenance, while digital commons are more and more used to detect cyber vulnerabilities in large-scale infrastructures. The discovery of a Log4Shell vulnerability in Apache Log4 in 2021 showed how underinvesting in maintenance can have negative impacts of the diffusion of knowledge as a whole;
- Second, contributors are guided by individual reward and incentives that can slow the development of digital commons. The addition of contributors focused

on their individual rewards can lead to a situation of overproduction of irrelevant data, referred to as a "tragedy of digital commons" (Greco & Floridi, 2003). In this situation, both human and artificial agents can pollute the digital commons by overproducing data. Humans spread spams and information corruption when artificial agents overproduce computer worms spreading through self-replication of copies and bandwidth useless consumption.

3.3. Communication gaps with tangible commons preventing active contributions to digital commons

Time and work capacity to maintain digital commons are insufficient without a strong sense of community to engage in collaborative management in the long term (Corvellec & Corvellec, 2018). This sense of community is strongly linked to the motivations for joining and contributing to FLOSS projects, which in turn are strongly related to the "hacker culture". In this culture, it is vital to showcase one's technical abilities at a community level to earn acknowledgement from fellow peers (Lakhani & Wolf, 2003). Furthermore, active engagement with a specific ideology (Moglen, 2003), undertaking demanding creative tasks without necessarily identifying oneself as a member of the community, and actively participating in a project while safeguarding its legacy are all significant aspects (Kelty, 2008)

Such engagement is particularly meaningful for protecting digital commons' resources as an "enduring process", and requires contributing communities to fully understand the principles of open-source and shared resources (de Rosnay & Stalder, 2020). This relates to Ostrom's principle of congruence between appropriation (access and re-use), provision rules (infrastructure necessary to host the work) and local conditions for protecting digital resources (flexible approaches rather than "one-size-fits-all").

However digital commons' full potential can only be delivered if they encompass tangible commons communities. Both communities are deeply intertwined to form "global commons" (Bettega et al., 2022). They are intertwined because tangible commons choices depend on intangible commons choices and vice versa; and

because digital “commoning practices” support tangible “commoning practices” and vice versa.

The role of the Framasoft digital common during the first lockdown in France is also a good example of this intertwining. Not only did the foundation provide vital infrastructures such as online appointment tools for the health care staff, but it also enables citizens to collaborate on services provided through the CHATONS collective of hosters, a collective of small structures managing servers and offering solutions of storage for internet users. The tool was very widely used both by digital and tangible commoners since the number of visits on Framatalk (visual conference tool) and Framapad (collaborative information) went up eightfold.

On commoning practices, common-oriented participatory platforms are also relevant since they can drive policy improvement with civil society engagement. Platforms in Iceland (2014), Barcelona (2017), and Taiwan (2018) are using commoning tools such as the EU DECODE project to develop alternatives to smart cities based on surveillance capitalism and central governance with commoners and hackers developing dedicated data commons.

However, it is important to underline that tangible commons are not the only ones to beneficiate from digital commons’ expertise; boundary organizations within digital commons often lack of non-digital expertise such as legal representation, marketing services or public affairs departments, and could beneficiate from tangible commons in that regard too.

The establishment of a European foundation for digital commons recommended by the European working team on digital commons in June 2022, could be a compelling step in bridging the gap between digital and tangible commons through more than a one-stop-shop with coercive and financial prerogatives.

However, no explicit financial support has been announced for the establishment of this foundation. The announced financial support was dedicated to the European

one-stop-shop to direct digital commoners towards appropriate fundings and for a dedicated call for proposals of digital commons with a European component.

4. Policy recommendations

4.1. Build regulatory certainty for digital commons through a harmonized next generation of public policy

A “next generation of public policy” leveraging markets, states and communities should be built at European and national level to address the specificities and needs of digital commons.

First, digital commons need standardization mechanisms for more legal certainty and to foster long-term trust:

- On ownership rights, standardization efforts should focus on harmonizing freedom principles and core clauses of digital commons licenses instead of doing this by adding options to simplify the whole system;
- On governance processes and value measurement systems, models enabling technical conception of digital commons and hosting capacities of associated communities, such as the joint digital initiative of the French National Agency for Territorial Cohesion and Agency of the Environment and Energy Management should be generalized and replicated when needed. In particular, “benevolent dictatorship” good practices should be included in standardized frameworks. These behaviors are specific to digital environments and refer to situations where anyone takes part in the decision process but only one protagonist / group eventually makes the decision.

Second, digital commons need some degree of modularity to retain the flexibility that is at the root of their success and operating mode:

- Amend the European public procurement system to systematically include reuse clauses in tenders;

- Use models like Wipedia with dedicated interfaces for “prosumers” of digital content to help reaching consensus in a transparent manner and address high versatility of digital commons;
- Implement dedicated dispute resolution systems and structures in European legal frameworks on the model of the ICANN Domain Name Dispute Resolution Policy (UDRP) addressing problems like cybersquatting[12], avatar use and data privacy issues around the use of IP addresses to identify fraudulent practices. The objective should be to provide dedicated spaces to diffusely located and loosely connected communities to solve internal and external conflicts.

Finally, ties between policymakers and digital commons should be reinforced to ensure successful enforcement and legitimacy of a “digital commons first” principle (Fuchs, 2021). European authorities should actively engage with “real appropriators”[13] of digital commons to make regulatory frameworks compatible with Common Based Peer Production (CBPP) models and thereby encourage digital commoners’ contributions on the long-term and at global level.

4.2. Focus European funding on digital commons boundary organizations

The objective of European funding of digital commons should be to support the independence of digital commons. To succeed, European funds should be focused on implementing dedicated structures - “boundary organizations” (O’Mahony & Bechky, 2008) - within digital commons focused on their maintenance, governance processes and operations management. European calls for proposals to finance digital commons should prioritize this objective and European funds should incorporate it explicitly in their investment thesis.

[12] Cybersquatting refers to registering a domain name to try to resell it to a trademark owner at higher cost or take advantage of its reputation.
[13] Commoners whose software depends on the first resource and who are willing to participate in the construction of the resource.

European funds could also replicate existing best practices in the market, such as low-thresholds to access to fundings like the German Sovereign Tech Funds' funding flexibility to adapt to community size and degree of maturity.

To go further, the independence of digital commons should also accompany European technological independence. One way to achieve this objective would be to dedicate a European Digital Infrastructure Consortium (EDIC) to digital commons. EDICs are new legal frameworks for multi-country, multi-sector and transversal projects introduced by the European Digital Decade policy programme for 2030 (article 15 of the European Council proposal for the European Parliament establishing the 2030 "path for a digital decade"). The European Commission could launch a call for expressions of interest for building effective and resilient boundary organizations in digital commons. In order for this call of expressions to be impactful, three member states or more need to answer. That means that political will and financial means are first needed at national level to be able to answer a European call for expressions of interests on digital commons. The example of the Important Projects of Common European Interest (IPCEI) "cloud at the center" launched in 2021 could inspire a digital commons EDIC. First, the cloud became the default hosting method for all ministerial applications and specific standards (SecNumCloud) were set. Second, France Relance through different funding vehicles (PIA 4) brought direct support to the development of cloud projects compliant with SecNumCloud standards. The most promising were then selected to be financed by the European IPCEI with 12 other member states to develop more efficient and greener European cloud services and infrastructures, as part of the European strategy to create a single market for data embodied by the Data Governance Act. In order for a viable and consistent EDIC on digital commons to emerge at European level, member states must first provide financial and operational support at state level, before combining their forces. To be consistent with commoners' culture and aspirations, an ARPA-like strategy should be followed in the EDIC, with ambitious goals, temporary project teams constantly rotating depending on investment priorities and a flat approach to innovation.

4.3. Use the European foundation for digital commons to reinforce ties with tangible commons

The European foundation for digital commons should enable the gathering of existing digital commons initiatives in a unique and recognized place. This will help reinforce the ties between digital commons and tangible commons and enable mutual recognition, while capitalizing on existing successes, which is consistent with the "use and reuse" commons' philosophy.

In particular, this foundation could be inspired from other successful foundations such as Wikimedia Foundation and Apache Foundation. Its first objective should be to support the development of existing digital commons and foster the use and re-use of the resources they produce by intangible commoners. In return, tangible commoners could share useful resources for digital commoners such as legal, marketing, financial and other operation-related resources for digital commons' boundary organizations. Within the digital commons community, non-digital skills are increasingly needed to build more resilient legal frameworks, more robust communication strategies, better management, and representation within political domains. These skills are often available in market-based corporations and other civil society communities. Digital commons community could leverage on the European foundation to get closer to these entities to reach the talents they need to achieve sustainable resilience.

The foundation could come up with innovative ideas to engage digital "commoners" in protecting and engaging with tangible "commoners" for the European digital infrastructure through a "give-give" approach. For example, fundings may be allocated using specific criteria, one of them perhaps being the involvement of the community supporting the digital common project in the maintenance of European digital infrastructures, in relation with European Computer Emergency Response Teams (CERTs).

This requires a tripartite governance structure, including digital commoners, relevant corporations/businesses involved in FLOSS projects and public representatives from

European countries that are already engaged and advanced in the development of digital commons.

The sustainability of robust and impactful digital commons heavily relies on the mobilization of civil society. From the perspective of civil society, digital commons often lack accessibility and visibility, which can create challenges for individuals who are not familiar with digital technologies, and therefore may struggle to understand the purpose of the commons and be willing to participate in them. To promote civil society participation in the building of digital commons, the European foundation for digital commons can increase awareness on the local level by engaging in targeted communication campaigns and promoting digital commons projects in schools as an example. Targeted incentives for national and local authorities to be more transparent about the governance choices they make about data collection and re-usability standards when launching digital commons initiatives could also be implemented.

Summary of policy recommendations

Recommendation 1: Build regulatory certainty for digital commoners via an innovative generation of public policies centered around digital commons

Standardized frameworks on ownership rights, value measurement system and governance processes should be implemented with harmonized legal tools for licenses and generalized models enabling technical conception and hosting capacity of digital commons.

Frameworks should remain modular to preserve the flexibility of digital commons' operating models through reuse clauses in public tenders, dedicated interfaces for "prosumers" of intangible resources and dedicated dispute resolution systems for internal and external conflicts operating at local and global scale.

Recommendation 2: European funding should be focused on building digital commons' boundary organizations to preserve their independence

It is crucial to prioritize the establishment of boundary organizations in the realm of digital commons. This priority should be explicitly incorporated into European calls for proposals and investment theses. Additionally, European funding mechanisms should appropriately consider the size and level of development of digital commons, ensuring funding thresholds align with their specific requirements.

This Policy Brief also proposes the creation of a European Digital Infrastructure Consortium (EDIC) specifically dedicated to digital commons. The EDIC's primary objective would be to establish strong boundary organizations for selected digital commons, which in turn would serve as enablers for digital sovereignty.

Recommendation 3: Use the European Foundation for digital commons to bridge the gap with tangible commons

The European Foundation for Digital Commons should promote the use and reuse of intangible resources by tangible commoners. Simultaneously, it should encourage the sharing of tangible resources with digital commoners, employing a carefully crafted "give-give" approach that suits their specific needs.

The Foundation would also gain from engaging with civil society by raising awareness on the benefits and importance of digital commons through targeted communication campaigns in schools, firms and local organizations.

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